TECHNICAL SPECIFICATION

ISO/TS 17425

First edition
2016-05-15

Intelligent transport systems — Cooperative systems — Data exchange specification for in-vehicle presentation of external road and traffic related data

Systèmes intelligents de transport — Systèmes coopératifs — Spécifications d'échange des données pour la présentation dans le véhicule de la route externe et des données relatives au trafic

Reference number
ISO/TS 17425:2016(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

Introduction

Traditional fixed road signs are positioned on road verges to inform drivers about the applicable regulations, or to warn them about dangers or to provide them with other general information – this can be considered as roadside signage information. Beyond this fixed signage, the newer technologies have now allowed for some time for more accurate dynamic presentation of roadside signage information depending on the actual road and environmental conditions using variable or dynamic message signs. With the advent of Cooperative Intelligent Transport Systems (C-ITS) it is possible to provide more focused and timely guidance to vehicle controllers and drivers by supporting continuous presentation of the content of roadside signage information in the vehicle along the impacted road section rather only during the short moments its takes for a vehicle to pass traditional road signs. Direct in-vehicle presentation of roadside signage information, called In-Vehicle Signage, facilitates the potential provision of information to specific classes or characteristics of vehicles, and for potentially more granular definition of affected road sections than stationary-position traditional fixed plate signs and use of variable/dynamic road signs. It does not deal with contextual speeds which are covered by ISO/TS 17426.

Delivering the In-Vehicle Signage service to road users can improve road safety, support traffic management, and reduce greenhouse gas emissions. It does not preclude other usage of the delivered information but such services are not in the scope of this Technical Specification.

All ITS services follow the same abstract process structure consisting of a sequence of detection (of an event) including pre-processing of the detected content, execution of the service algorithm (processing of detected content), and presentation or utilization of the service result. Figure 1 (extracted from ISO/TS 17427) summarizes and details this process structure.

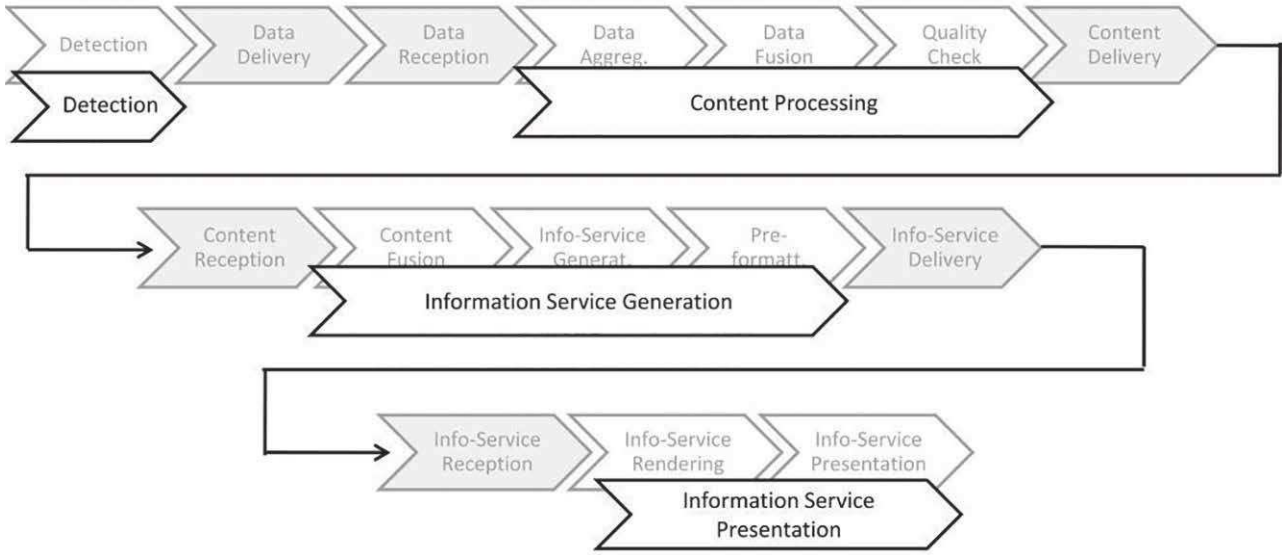


Figure 1 — General description of process for In-Vehicle Signage (from ISO/TS 17427:2014, Annex A)

Based on this abstract and general description of process steps in an ITS service, a large number of possible scenarios can be derived. This is true for In-Vehicle Signage. Every step in the process chain can be executed by different actors or stakeholders. Additionally, the execution of a process step for different spatial areas may be delivered by different actors. Each combination of different actors for different process steps can be used to identify distinct scenarios.

Assuming that there are two main stakeholder groups in C-ITS, the Infrastructure stakeholder and the Vehicle stakeholder, multiple combinations, and therefore multiple scenarios, are possible as every step might be delivered by either stakeholder group (see Figure 2) or shared between both stakeholder groups (see Figure 3).

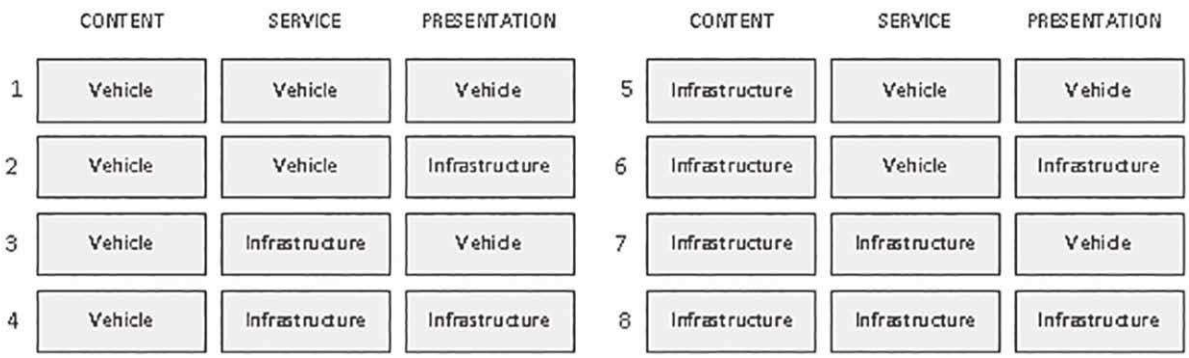


Figure 2 — Possible scenarios — Simple combinations

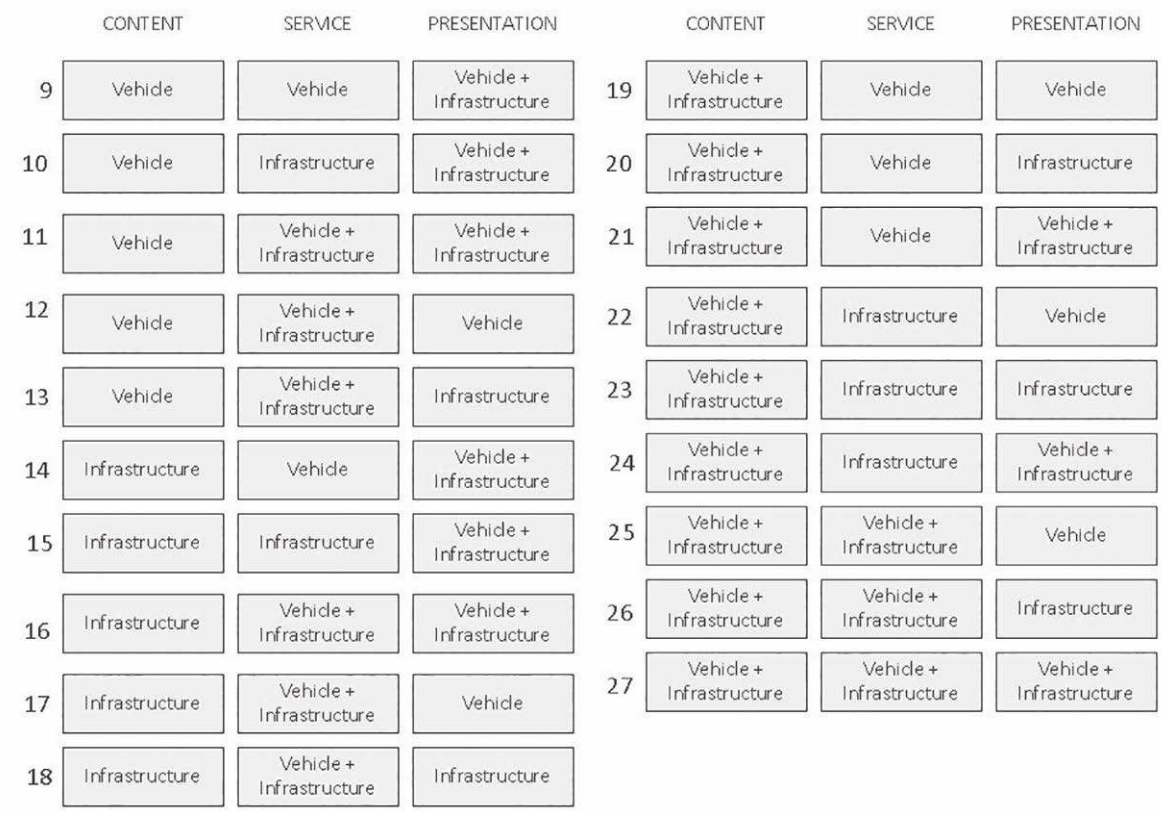


Figure 3 — Possible scenarios — Complex combinations

Every scenario is one specific of combination of stakeholders executing process steps. This Technical Specification addresses the scenarios where detection, content pre-processing, and the information service generation (see Figure 1) are delivered under the responsibility of the infrastructure stakeholder group (scenario 7 as seen in Figure 2). In scenario 7, the information service presentation takes place in the vehicle. Scenario 7 is considered in detail in this Technical Specification.

The defined C-ITS applications rely on the functionality and procedures defined within the Communications Architecture and by the reference ITS station architecture (as defined in ISO 21217 and other International Standards or Technical Specifications from the C-ITS standard set).

Annex A and Annex B contain profiles that define an instantiation for the IVS service. Annex A and Annex B contain conditional mandatory requirements. There is no need to comply with these requirements to claim compliance with this Technical Specification.

Annex A contains a profile that is communication technology agnostic. Annex B contains a profile that is focused on ITS-G5. For details on the referenced standards, see the introduction of the corresponding Annex.

These profiles are expected to be implemented and validated in European initiatives. Based on the results of these initiatives, it is intended to specify one interoperable solution in a future version of this Technical Specification.

Intelligent transport systems — Cooperative systems — Data exchange specification for in-vehicle presentation of external road and traffic related data

1 Scope

This Technical Specification specifies the In-Vehicle Signage service and application that delivers In-Vehicle Signage information to ITS stations (vehicle ITS stations or personal ITS stations devices) concerning road and traffic conditions, qualified by road authorities/operators, in a consistent way with road authority's/operator's requirements, in the manner that is coherent with the information that would be displayed on a road sign or variable message sign (VMS).

NOTE A Variable Message Sign is also named dynamic message sign. Both terms are considered as synonyms and can be used interchangeably. In the text below, only variable message sign and its abbreviated term VMS are used.

This Technical Specification defines the following:

— the In-Vehicle Signage service and the In-Vehicle Signage application that instantiates this ITS service;

— the requirements to be fulfilled by the In-Vehicle Signage service;

— the requirements for using functions provided by the ITS station facilities layer supporting the use of the In-Vehicle Signage service;

— the ITS-S application processes in the different ITS station, that instantiate the In-Vehicle Signage ITS service.

This Technical Specification also specifies: the sets of communication requirements and objectives (profiles) using the methods defined in ISO/TS 17423 to select the level of performance (best effort or real-time, etc.), confidence and security (authentication, encryption, etc.) for each communication flow between ITS stations in the scope of the In-Vehicle Signage service.

This Technical Specification defines the selection of relevant functions and procedures provided by the ITS station facilities layer (ISO/TS 17429) and defines the message structure, content, syntax, atomic elements to be used by the In-Vehicle Signage application.

NOTE This application is colloquially called "In-Vehicle Signage".

The In-Vehicle Signage service includes the on-board information management. This management ensures contextual coherence of the end-user ITS service (e.g. vehicle characteristics, message priority, etc. avoiding amongst others things the presentation of conflicting information to end-users).

The production of information supporting the In-Vehicle Signage application, its qualification, and its relevance are out of the scope of this Technical Specification.

This Technical Specification does not specify the design of in-vehicle Human Machine Interfaces (HMI), but it does specify requirements that such interfaces shall be capable of supporting in order to permit the correct dissemination and use of information provided by the In-Vehicle Signage service.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 639-1, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 21217, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

ISO/TS 14823, *Traffic and travel information — Messages via media independent stationary dissemination systems — Graphic data dictionary for pre-trip and in-trip information dissemination systems*

ISO/TS 16951, *Road vehicles — Ergonomic aspects of transport information and control systems (TICS) — Procedures for determining priority of on-board messages presented to drivers*

ISO/TS 17423, *Intelligent transport systems — Cooperative systems — ITS application requirements and objectives for selection of communication profiles*

ISO/TS 17429, *Intelligent transport systems — Cooperative systems — Profiles for processing and transfer of information between ITS stations for applications related to transport infrastructure management, control and guidance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO/TS 17423, ISO/TS 17429, and the following apply.

3.1
additional service
IVS service able to deal with the lower levels of message priority

3.2
communication authority
entity in charge of regulating telecommunications and/or broadcast services

3.3
core service
IVS service able to deal with the two highest levels of message priority

3.4
driver awareness zone
DAZ
parts of road network on which a message is present to inform drivers about upcoming situations

3.5
HMI control unit
in-vehicle device that manages prioritisation and presentation of messages designed for consumption by vehicle occupants

3.6
in-vehicle signage
in-vehicle signage service
IVS
ITS service that provides receiving ITS stations in order to inform drivers about static as well as dynamic road signs and variable message signs

3.7
IVS application
ITS-S application process that instantiates the IVS service

3.8
IVS application service provider
application service provider
service provider
entity that executes the corresponding ITS service

Note 1 to entry: According to ISO/TS 17427, its role can be defined as collecting the content that is required to run the IVS service, running the IVS service and providing a suitable service response.

3.9
IVS content service provider
content service provider
content provider
source of the *in-vehicle signage* (3.6) information

Note 1 to entry: According to ISO/TS 17427, its role can be defined as providing the information content for the IVS service.

3.10
IVS message
message generated for the *in-vehicle signage* (3.6) ITS service as specified in this Technical Specification

3.11
IVS receiving ITS station
ITS station that receives and processes the *IVS messages* (3.10)

Note 1 to entry: It can be either a vehicle ITS-S or a personal ITS-S.

3.12
IVS sending ITS station
ITS station that generates and transmits the *IVS messages* (3.10)

Note 1 to entry: It can be either a central ITS-S or a roadside ITS-S.

3.13
minimum dissemination area
MDA
parts of the road network where the *IVS message* (3.10) can be received by the potentially targeted vehicles

3.14
qualified information
information issued by authorised sources (road authorities, traffic managers) for their operated network

3.15
relevance zone
RZ
parts of the road network for which the *IVS message* (3.10) is valid

3.16
traffic manager
entity in charge of operating a road network and managing traffic

Note 1 to entry: For this Technical Specification, this entity is also considered as an enacting road authority; although in some circumstances, these different activities can be operated by separate entities.

3.17
validity end time
STO
time from which the *IVS message* (3.10) shall no longer be presented

3.18
validity start time
STA
time from which the *IVS message* (3.10) shall be presented

4 Symbols and abbreviated terms

ADU	Application data unit
BSMD	Bounded secured managed domain
C-ITS	Cooperative intelligent transport systems
C-ITS-S	Central ITS station
DAZ	Driver awareness zone
DMB	Digital multimedia broadcast
DMS	Dynamic message sign
HMI	Human machine interface
ICT	Information and communication technologies
ITS	Intelligent transport systems
ITS-S	ITS station
ITS-SU	ITS station unit
ITS-SCU	ITS station communication unit
IVS	In-Vehicle Signage
LDM	Local dynamic map
MDA	Minimum dissemination area
P-ITS-S	Personal ITS station
R-ITS-S	Roadside ITS station
RZ	Relevance zone
STA	Validity start time
STO	Validity end time
TCC	Traffic control centre
TMC	Traffic management centre

NOTE 1 TCC and TMC are considered as synonyms and can be used one interchangeably. In the text below, TCC will be used.

V-ITS-S	Vehicle ITS station
VMS	Variable message sign

NOTE 2 VMS and DMS are considered as synonyms and can be used interchangeably. In the text below, VMS will be used.

5 Service definition and main concepts

5.1 General

The IVS service aims to provide information to road users from an authorized IVS content provider presented in the vehicle in a manner that is consistent with that of VMS or road signs. This information

is provided to drivers aiming to improve road safety, reduce environmental impact, and enhance traffic flow.

NOTE 1 The information conveyed within an IVS message is the information that is available on fixed road signs on roadside or on a VMS.

NOTE 2 In most circumstances, the IVS information is expected to be qualified by road authorities/operators, in a consistent way with road authority's/operator's requirements, in the manner that is coherent with the information that would be displayed on a road sign or a variable message sign (VMS).

Traffic information is presented automatically or at the request of the user.

Where possible, it is presented in the vehicle in a language chosen by the end-user.

NOTE 3 Such an ITS service is relevant when driving a terrestrial road vehicle but not for pedestrians. When in this Technical Specification it is said of vehicle it does not imply the ITS service is only based on Vehicle ITS-station. It may also be operated with a personal ITS-station present in a vehicle. In both cases, the information is presented to the driver through an adapted HMI.

Figure 4 — Example of dynamic message display

Every IVS message presented from the In-Vehicle Signage service can depict either a road sign or a variable message sign. Annex C provides some background information on road signage and Annex D on VMS technologies.

The static information on static road signs and VMS is managed through catalogues. There are two levels of pictogram catalogues:

a) the international level through the Convention on road signs and signals (also known as the Vienna convention - UNECE) used in around 100 countries;

b) the national level (generally defined through regulations) (like e.g. in France: Regulation of 1967).

NOTE 4 For countries having signed and ratified the Vienna convention, the national level is mainly based on this convention and only presents minor differences with the convention content. There may also be some slight differences regarding the used pictograms among countries for the same meaning.

NOTE 5 They allow independence between the content and its restitution. It needs to be updated when necessary.

Within IVS, messages are being defined including a priority scheme for HMI usage within the IVS service. Messages are being delivered to the HMI module, how the information is presented to the driver is the responsibility of the equipment supplier. Information covered by the primary services should be handled in the HMI with higher priority resulting in presentation to the driver in the driver awareness zone at least once.

Overall priority cannot be determined by a single ITS service. This is dependent on the context and all active ITS services inside the vehicle.

NOTE 6 The importance of high quality and safe HMI is recognized. However, as stated in Clause 1, HMI is out of the scope of IVS. IVS will be one of the ITS services/ITS applications available in-vehicle. How these ITS applications will work together in a harmonized manner is not specified in this Technical Specification.

5.2 Service definition

5.2.1 Definition

The In-Vehicle Signage ITS service supports the provision of information from an ITS-station to another ITS-station concerning either static or dynamic information about traffic conditions and traffic regulations. In countries where it is allowed, it can also include not directly traffic-relevant messages that can be displayed on variable message signs. The information is provided by traffic managers or authorized content providers to drivers seeking improved road safety, reduced environmental impact, and enhanced traffic flow.

NOTE The information is provided via a central or roadside ITS-station to another ITS-station located in a vehicle. Other schemes are possible such as messages hopping between ITS-stations in vehicles. This information is available on fixed road signs or variable message signs (VMS) on the roadside or mounted above specific lanes.

5.2.2 Message categories

The “In-Vehicle Signage” ITS service implements the following two message categories that are considered as part of service levels:

a) higher priority messages associated with core services (see 5.2.3);

b) lower priority messages associated with additional services (see 5.2.4).

5.2.3 Core services

The core services implement the following two message types:

a) Immediate danger warning message type: a warning alert concerning a danger involving drivers’ or other users’ safety.

   NOTE 1 According to the UNO convention on traffic signs and signals (known as the Vienna convention), such warning messages are provided using either triangle-shaped or diamond-shaped signs depending on convention choices in specific countries.

   NOTE 2 Typically on motorways or dual carriageway roads presentation of immediate danger warning messages is given at this distance between 2 km and 5 km from the danger, this varies according to national or regional rules. On other roads and in urban areas, this distance is typically shorter.

b) Regulatory message type: prohibition, restriction, obligation or special regulation (that may depend on the vehicle type), compulsory routes, and rerouting.

NOTE 3 Regulatory messages are subject to relevant local/national legislation enacted by and recognized in law. Such regulatory messages may be relevant to specific classes of vehicle, driver qualifications, vehicle loads, environmental conditions, etc.

NOTE 4 According to the UNO convention on traffic signs and signals (known as the Vienna convention), such prescriptions are generally provided using round-shaped signs.

5.2.4 Additional services

Secondary services are related to messages of more general interest. Secondary services implement one or several of the following message types:

a) Traffic-related information message type: events (that do not create not immediate dangers), driving conditions, forecasts (for traffic congestion, weather, events), travel time, advisory alternate route, etc.

b) Pollution message type: there are commonly two forms of such messages: information messages and warning messages. Both forms of message exclude driving prohibitions or obligations which are part of core service.

c) Not traffic-related information message type including but not limited to examples such as abduction alerts also sometimes called “amber alert”.

5.3 Fundamental parameters

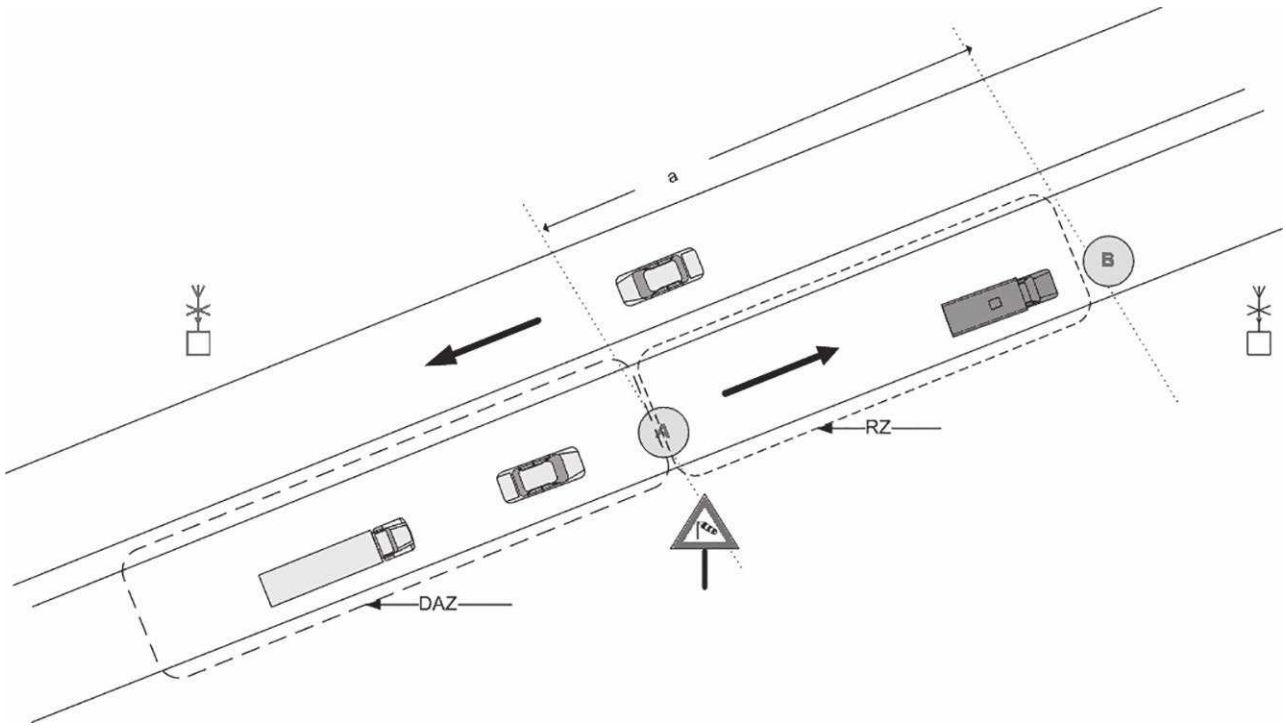
5.3.1 Spatial relevance

Two fundamental parameters characterize an IVS message spatially that are:

— Relevance zone (RZ) which is defined by the parts of road network for which the IVS message is valid.

— Driver awareness zone (DAZ) which is defined by the parts of road network before entering the relevance zone, allowing presentation of the corresponding message to the driver in advance of entering the Relevance zone.

The two parameters are illustrated in Figure 5 below.



Key

RZ relevance zone

DAZ driver awareness zone

a The relevance of the information that would be displayed on a road sign (or VMS) extends from A to B.

Figure 5 — Fundamental spatial parameters for IVS

NOTE 1 RZ or DAZ can be of length null (i.e. featured as a point). In the case where DAZ is of length null, it may be omitted.

NOTE 2 The DAZ of an IVS message can also include more than one road element where this message is also pertinent for drivers (modifying their route, etc.).

Annex E provides some information on the RZ topology for the road signs defined in the Vienna convention.

Minimum dissemination area (MDA) is defined by the area covering the minimum parts of the road network where an IVS message shall be transmitted for receipt by the potentially targeted vehicles.

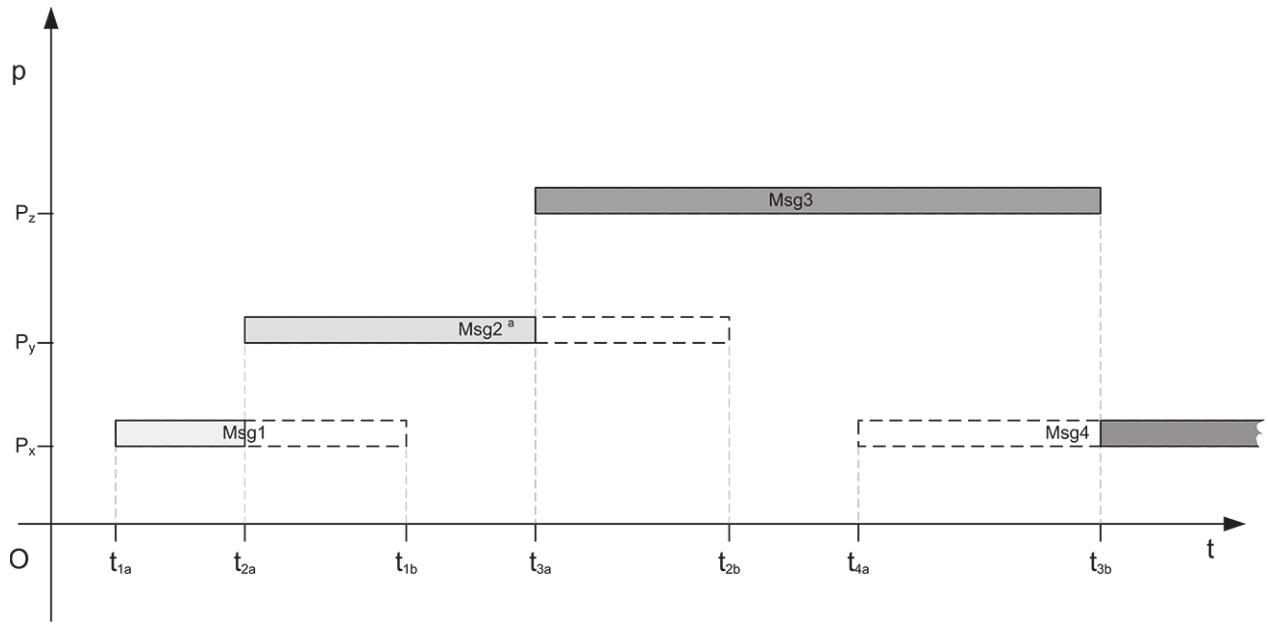
5.3.2 Temporal validity

To characterize the temporal validity of an IVS message, two fundamental parameters are defined:

— validity start time (STA) which is the time from which the IVS message is valid;

— validity end time (STO) which is the time from which the IVS message is no longer valid.

A driver can successively meet along his/her route several road signs or VMS which can have overlapping RZ and different priority levels. Figure 6 presents an example of such a case.



Key

t time scale (t_{1a}, t_{1b}, t_{2a}, … represent different periods of time), e.g. Msg1 is valid between t_{1a} and t_{1b}

p priority level scale (p_x, p_y, p_z represent different levels of IVS message priority)

a The plain part of each bar represents when a message is transmitted to the HMI unit, whereas the dashed part represents when the message is stored in the receiving ITS-S and not transmitted to the HMI unit.

Figure 6 — Temporal relevance of several IVS messages

NOTE Temporal validity is an absolute concept based on a timeline whereas the spatial relevance is relative to the vehicle location, vehicle heading, and other vehicle characteristics.

5.3.3 Other parameters

Other parameters are to be taken into account when determining which vehicles and drivers are targeted such as vehicle characteristics, driver's licence status, weather conditions, etc.

5.4 Example of system implementation

5.4.1 General description

Figure 7 illustrates an example of a possible system architecture implementing the IVS service.

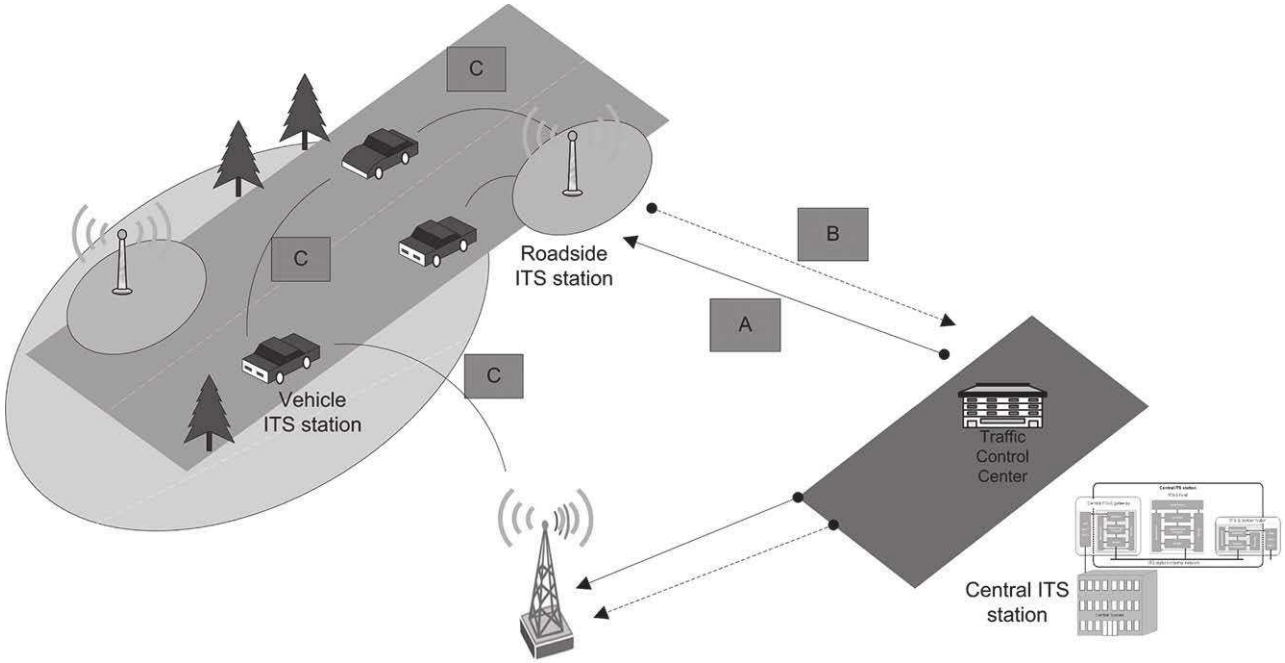


Figure 7 — Example of system architecture

5.4.2 Interface identification

The main interfaces are depicted on the figure above as follows.

A: Update of the IVS message by central ITS station (traffic management centre, WEB server, Mobility server, etc.)

B: Verification of the IVS messages being broadcasted

C: Broadcasting of IVS messages to in-vehicle ITS Stations

NOTE 1 The update and verification of an IVS message may be also achieved by a local personal ITS-S (smartphone, USB key…etc.).

NOTE 2 Other interfaces can also be considered according to the choice made by the road/traffic operator.

6 Roles and responsibilities

6.1 Scenarios for In-Vehicle Signage

This subclause describes system operation including provision of content, provision of service, and provision of presentation. In the next subclauses, the different scenarios for In-Vehicle Signage are described based on the general scheme as presented in Figure 8.

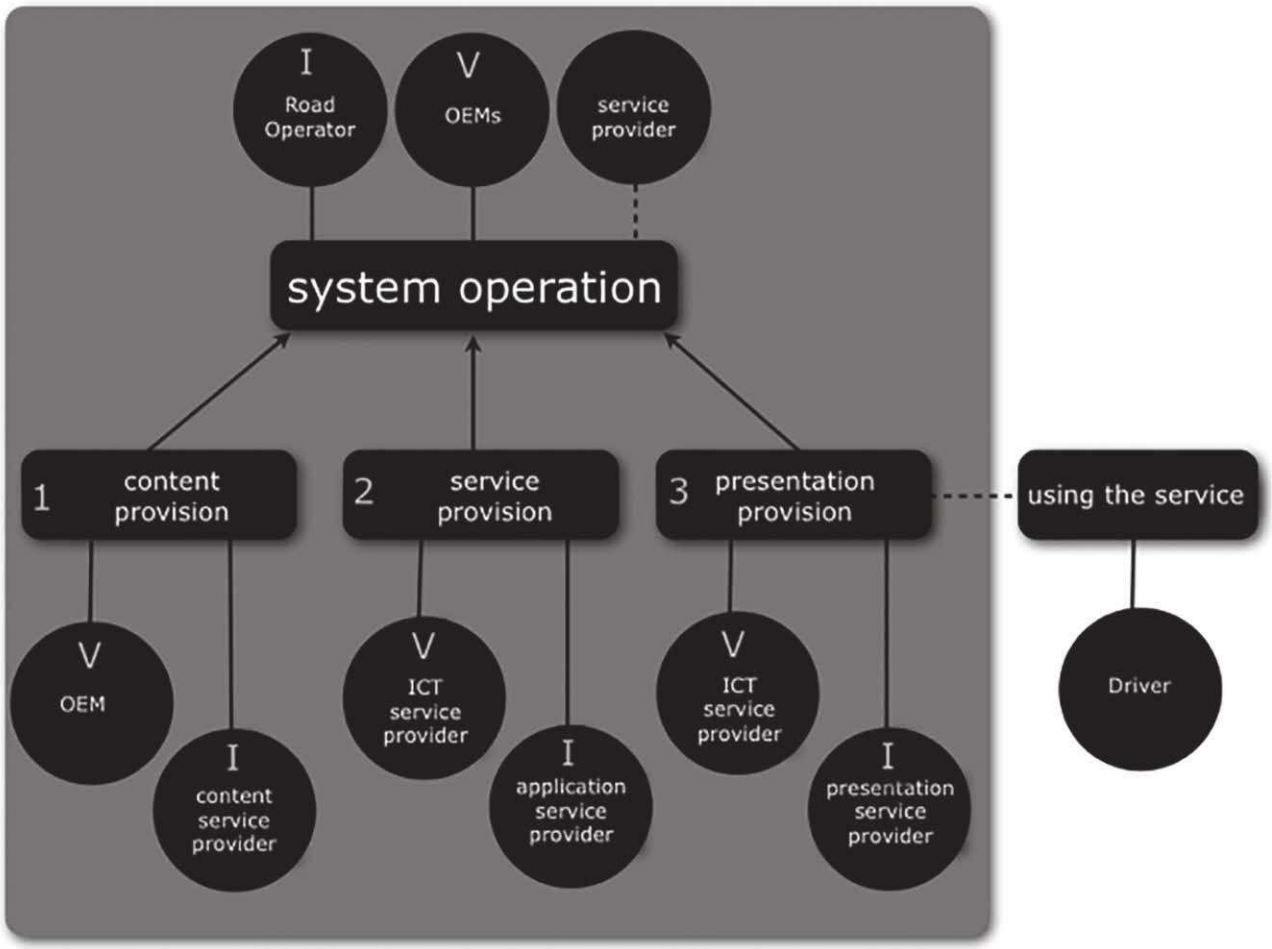


Figure 8 — General roles and actors for In-Vehicle Signage

In Figure 8, the character "V" in balloons in the figure stands for actor(s) responsible for the vehicle and/or nomadic devices in the vehicle (V-ITSS, P-ITSS). The character "I" in balloon stands for actor(s) responsible for the roadside infrastructure, e.g. the central ITS-station of a Traffic Control Centres (C-ITSS) or roadside ITS-stations (R-ITSS).

The roles are split into two levels, on the high level is the role Service provision. This can be fulfilled by actors from "V" and/or "I". For "I", the responsibility will be with the traffic manager; for "V", the responsibility will be determined by OEMs.

NOTE 1 Service providers probably will be involved in the future.

The role "System operation" is split up in the roles Content Provision, Service provision, and Presentation Provision.

NOTE 2 A detailed description of the different roles and their relationships can be found in ISO/TS 17427.

According to the general description of the service, the focus is set on scenario I–I–V, Figure 8. For this scenario, the responsible actor for the role of system operation probably will be the actor responsible for the roadside infrastructure (I). The responsibility might be shared with the actor responsible for the vehicle (V) – this is illustrated by the dashed line.

NOTE 3 As explained in the Introduction of this Technical Specification, it can be named "scenario 7".

NOTE 4 The notation used in the different figures of Clause 6 is explained in an informative annex of ISO/TS 17427.

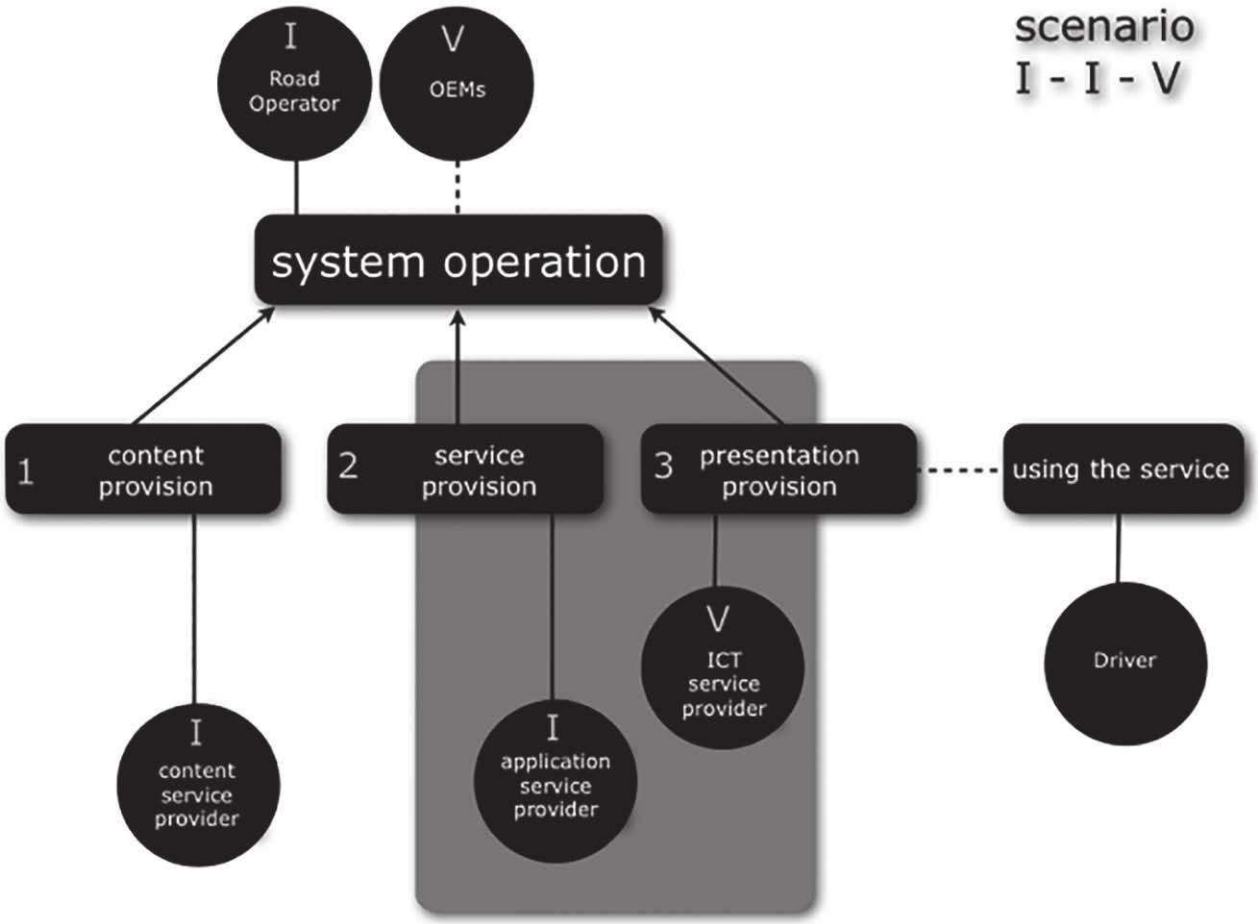


Figure 9 — Roles and actors for In-Vehicle Signage — Scenario I–I–V

The actor responsible for the role of content provision is the content service provider from the field of roadside infrastructure.

The actor responsible for the role of service provision is the application service provider from the field of roadside infrastructure.

The actor responsible for the role of presentation provision is the ICT service provider from the vehicle side.

6.2 System operation roles in scenario I–I–V

For In-Vehicle Signage, Figure 10 details the service provision onwards.

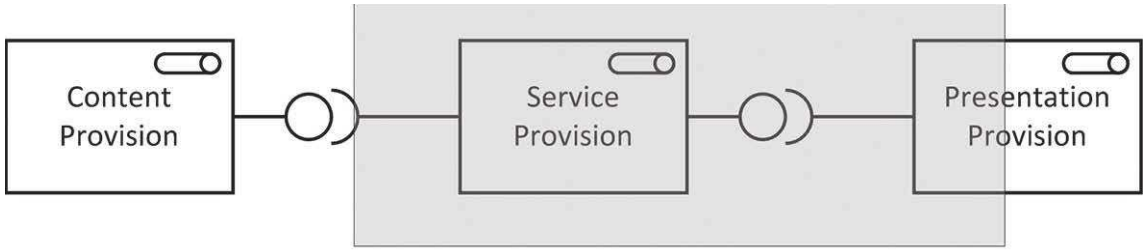


Figure 10 — Focus of In-Vehicle Signage — Process level

The grey box in Figure 10 indicates the focus of In-Vehicle Signage put on process level. It is assumed that the content production is done according to specifications (e.g. national standards/regulations), which are not part of the scope of this Technical Specification. Therefore, it only considers roles and responsibilities for content, service, and presentation provision.

There is also a more technical communication level that needs attention. Figure 11 shows the relation between service provision and communication management, as well as the presentation provision.

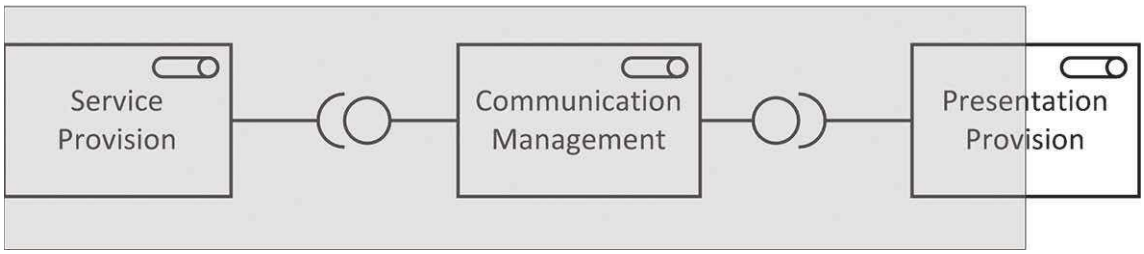


Figure 11 — Communication management

6.3 Possible actors in In-Vehicle Signage

For In-Vehicle Signage, two technical implementations are foreseen: long-range and short-range communications. The following two pictures show the possible actors for both implementations.

For illustrative purposes, Figure 12 shows a possible implementation using a range of long-range communications (3G, 4G, DAB, etc.). There is a wide-area communication operator providing the communication means. Therefore, the role Communication Management is fulfilled by the wide-area communication operator.

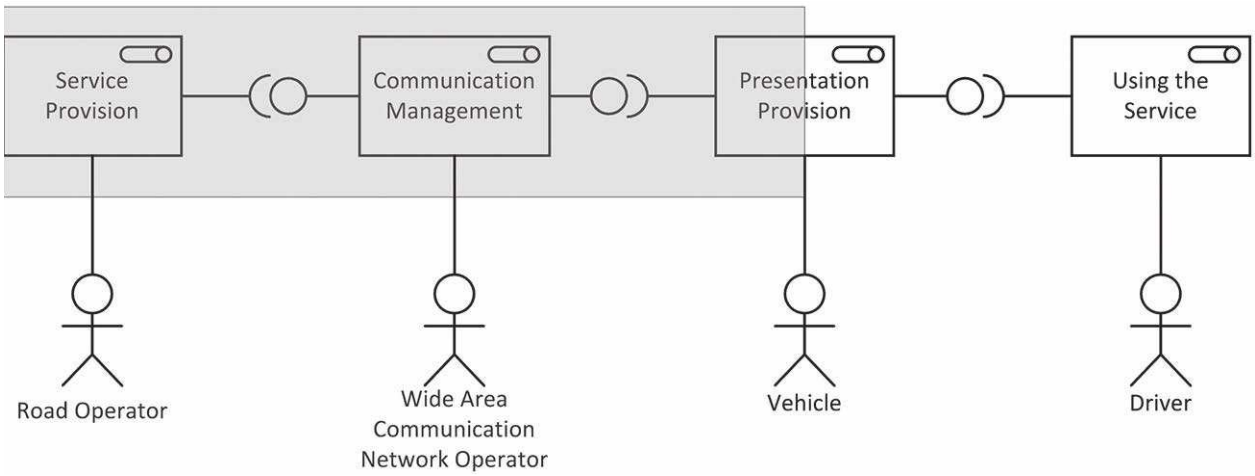


Figure 12 — Assignment of actors in case of usage of wide-area communications

Figure 13 shows a possible implementation using short-range communication (e.g. G5). Short range communication makes use of ad hoc networks. There is no separate entity for operating these networks. Therefore, the parties involved in these ad hoc networks share the role of "Communication Management". In this case, the actor responsible for "Service Provision" has a second role: "Communication Management". The same applies for "Presentation Provision".

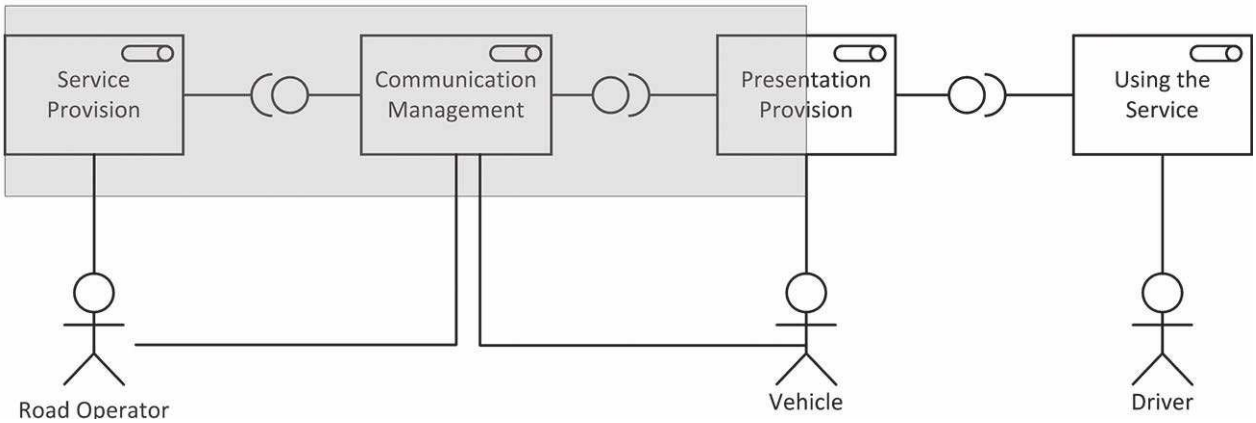


Figure 13 — Assignments of actors in case of usage of local area communications

Although the responsibility of the presentation is within the vehicle, rules and regulations applicable need to be considered. The responsibility for these regulations is within the role of the policy framework.

7 Requirements and recommendations

7.1 General

The requirements defined in the following subclauses are not directly dedicated to a type of equipment, but are applicable to the ITS service in operation and consequently to the ITS applications instantiating it. Some general requirements cannot be tested using mechanisms such as defined in the ISO/IEC 9646 series. However, functional requirements are also relevant because they structure the ITS service and the ITS applications with it.

The In-Vehicle Signage service shall comply with the applicable national regulations of the country/region where it is operated.

7.2 General requirements

The In-Vehicle Signage service, its messages, and their content are designed to be used for receipt of IVS information into vehicles. This design foresees the In-Vehicle Signage service being supported by the use of either a vehicle ITS-S, or a personal ITS-S, that is being used for receiving IVS information and processing for using the IVS service. These are collectively referred to as IVS receiver ITS station.

GR010: The In-Vehicle Signage service shall be able to provide information on one or more road signs or the multi-part content of traffic Variable Message Signs as defined by the choice of the Content Provider.

GR020: The minimum level of service for In-Vehicle Signage service shall include the core services (message types 1 and 2), as defined in 5.2.3.

GR030: All ITS applications instantiating the IVS service shall comply with this Technical Specification.

GR040: The versions of the implemented IVS application and of the data structures used for the service shall be identified.

7.3 Message content

CR010: If present, the coding of road signs or pictograms used in a Variable Message Sign that is encoded in an IVS message shall be done using ISO/TS 14823.

CR020: The IVS message shall contain identification of the Content Provider.

CR030: The IVS message shall contain a unique identifier in order to support message management.

CR040: The IVS message shall provide an appropriate message type (priority), as defined level in 5.2.3 and in 5.2.4.

CR050: The IVS message shall be structured such that it can contain text in multiple languages.

CR060: The IVS message shall provide information on any limitations to relevance defined by vehicle characteristics, vehicle class, vehicle usage, and road user profile if the IVS message contains such limitations.

CR070: The IVS message shall include the information on its relevance zone where it is relevant, driver awareness zone. In the case where DAZ is of length null, it can be omitted in the IVS message.

NOTE 1 For the definition of these concepts, see 5.3.1.

NOTE 2 Where appropriate, the relevance zone and driver awareness zone may define specific road elements and/or lanes.

CR080: Where appropriate, the relevance zone should contain information on the impacted traffic direction(s) and lane(s).

NOTE 3 The location of the vehicle is also to take into account when defining the priority rules of message presentation. Indeed, during a journey, a driver will be able to meet a significant number of VMS displaying information of operation action. RZ and/or DAZ of these messages may overlap. The vehicle location gives a priority weight for each message.

CR090: the IVS message should contain information on the validity start time and, when available, information on the validity end time.

CR100: In an IVS message, the language used for textual message parts (e.g. the free text content displayed on a Variable Message Sign) shall be identified in accordance with ISO 639-1.

CR110: Where appropriate, when dimension specific attributes are included in the IVS message, an indication of the measurement unit being used shall be provided.

NOTE 4 In the United Kingdom, the United States of America, and some other countries, speed information is given in miles per hour. In other European countries, speed information is provided in kilometres per hours. When numeric values are supplied, the associated units of measurement need to be defined. Similarly, by way of an example, vehicle length limitation is given in metres in Europe, whereas it is given in feet and inches in USA.

CR120: In case of full-matrix signs or assimilated (like rotating prisms sign), where there is no other possibility to describe the content in terms of data elements, the content can be encoded as a compressed JPEG file.

NOTE 5 This possibility is reserved for very exceptional cases.

7.4 Message management requirements

7.4.1 IVS sending ITS station requirements

MR010: The Service Provider responsible for distributing IVS messages to IVS receiver ITS station shall be authorized and provide authentication.

MR020: The IVS sending ITS station allocates a unique message identifier and a message generation time in combination for each IVS message that it generates.

MR030: The IVS message unique identifier shall be retained for IVS messages relating to the same sign or Variable Message Sign locations, i.e. different displayed signs at the same location showing a change in status of, say, road surface conditions, changing traffic conditions, etc. The IVS message generation time is used to time-stamp different versions of related messages.

MR040: Where updated information is available about signs or Variable Message Sign content that is distributed via IVS messages from an IVS sending ITS station, the updated information shall be distributed in an IVS message with the same identifier as earlier related IVS messages.

MR050: The IVS message generation time shall relate to the time that a first version of an IVS message is generated. Only when different and updated information is distributed shall the message generation time be updated. In the case of resending of the same message content, without change, the message generation time shall not be updated.

MR060: When IVS information is no longer valid or the situation leading to signage is no longer present or considered significant by the Content Provider, a specific IVS cancellation message with the same identifier as earlier related IVS messages shall be created.

NOTE This possibility is reserved for very exceptional cases.

MR070: When IVS information is considered as ended or foreseen to end at a given time by the Content Provider and this information was not provided previously, a specific IVS end message with the same identifier as earlier related IVS messages shall be created.

MR080: On creation of an IVS message, the Content Provider shall provide information in the message itself about its relevance and validity (validity status, start of the period of validity, end of the period of validity if available, applicability of the information with respect to vehicle types, vehicle characteristics, vehicle usage, or vehicle driver profiling).

7.4.2 Roadside ITS station

MR090: Roadside ITS station shall broadcast all of the valid IVS messages.

NOTE IVS messages are considered to be valid when (1) the current time of the roadside ITS Station is greater or equal to the validity start time of the IVS message to be distributed; and (2) that the current time of the roadside ITS Station is less than or equal to the validity end time of the IVS message to be distributed, when it exists.

7.4.3 IVS receiving ITS station requirements

MR100: The IVS receiving ITS station shall determine if the received IVS information is relevant taking into account the driving direction. It also should take into account where it is provided, the carriageway, the lane used, and the vehicle characteristics.

MR110: The IVS receiving ITS station shall check the validity times contained in the received IVS message and check if the current time in the IVS receiving ITS station is not greater than the Validity End Time of that IVS message, where it is provided.

MR120: If the Content Provider or Service Provider is not authenticated and/or authorized, the corresponding IVS message shall be cancelled at the IVS receiving ITS station.

MR130: The IVS receiving ITS station shall retain IVS message information as long as the Validity End Time of the message has not been passed. It should retain the IVS message information as long as this ITS station is located in the relevance zone or if passed in a given time defined by a system parameter.

MR140: The IVS receiving ITS station shall update the retained IVS message information when an IVS message having the same identifier and later message generation time is received. Only the last version of an IVS message is stored under the conditions defined in MR150.

MR150: The IVS receiving ITS station shall remove IVS message information when the cancellation message having the same identifier and later message generation time is received.

MR160: The IVS receiving ITS station shall remove IVS message information when the end message having the same identifier and later message generation time is received. If a validity end time is provided with the end message, the removal of the message only occurs when the validity end time has been passed.

MR170: The IVS receiving ITS station shall remove IVS information once the pre-determined period of time defined by a system parameter after having received the last message has elapsed, where the IVS service is operated on a broadcast basis (repetition rate defined).

7.4.4 Transmission of IVS information to the HMI control unit

MR180: The IVS receiving ITS station shall transmit valid and relevant received IVS message content to the HMI control unit.

NOTE 1 The corresponding presentation is safely made when driving according to HMI regulations and standards.

MR190: Noting the conditions given in the requirement below, the IVS receiver ITS station shall transmit the received IVS message content to the HMI unit if the current time of the IVS receiver ITS station is equal or greater than the IVS message validity start time and the current time of the IVS receiver ITS station is less than or equal to the IVS message validity end time.

In cases where no validity end time has been provided for an IVS message and the message validity is not given as permanent, the IVS message can be considered to be valid during the period from the start of validity to the time of receipt of the IVS message at the IVS receiving ITS station plus a duration defined by a system parameter.

MR200: If the type of vehicle to which the IVS message content applies does not correspond to the indicated type of vehicle of the IVS receiver ITS station, this IVS message shall not be transmitted to the HMI unit.

MR210: If the current location of the IVS receiver ITS station is not located in the relevance zone or driver awareness zone as defined by the IVS message content, this IVS message shall not be transmitted to the HMI unit.

MR220: If the traffic direction for which the IVS message is applicable does not correspond to the current driving direction of the IVS receiver ITS station, the message shall not be transmitted to the HMI unit.

MR230: The message shall be transmitted to the HMI control unit when the IVS receiver ITS station enters the DAZ (or if null or omitted, RZ).

NOTE 2 The message may be stored into the vehicle long before and transmitted only when the vehicle enters the driver awareness zone.

MR240: The message shall be transmitted to the HMI control unit, according to priority management rules, when the message validity start time has been passed.

MR250: The messages that are not presented shall not be cancelled. The IVS application shall carry out a new analysis on the stored messages to assess whether one needs to be transmitted to the HMI control unit when an IVS message is no longer valid or has been given as removed of the HMI control unit.

NOTE 3 This requirement is justified by the IVS message hierarchy (see 5.3.2).

MR260: The different IVS messages shall be transmitted to the HMI control unit according to the following decreasing priority order based on the IVS message type:

a) immediate danger warning messages;

b) regulatory messages;

c) traffic-related information messages;

d) pollution messages;

e) not traffic-related information messages.

NOTE 4 The exact definition of the message types is provided in 5.2.3 and in 5.2.4.

This priority management only deals with IVS messages. When required, it is possible to explicitly override this priority level and therefore to allocate a higher level priority to an IVS message.

7.5 Recommendations for information processing in relation with the presentation to vehicle drivers

Successful use of the IVS services depends upon relevant IVS information being presented to vehicle drivers in a suitable, appropriate, proportionate, non-distracting manner. The design of the IVS application, as defined in this Technical Specification, supports a range of contextual information for transmission from the infrastructure to the vehicle that indicates the relevance, validity, and priority of IVS information, besides the IVS content itself. There is the strong desire for the IVS information to be presented in the correct context and therefore appropriate use of this contextual information via the HMI unit is strongly recommended. The scope of this Technical Specification does not include the design or functionality of HMI units.

PR010: Every IVS message should be presented in an unambiguous way so that it can be easily distinguished by a driver from any other message.

PR020: When the HMI unit allows for highlighting IVS messages, this should be consistent with the choice of the Content Provider to highlight the IVS message or not.

PR030: For languages where the writing directionality is variable, the IVS message should be presented using the text direction defined by the Content Provider.

NOTE 1 This requirement is defined for accommodating the different cases of text directionality. Some languages can be written horizontally, others vertically. For some specific languages, the same text can be written either horizontally or vertically according to the choice made by the Content Provider. As well, the horizontal text direction may change from left-to-right to right-to-left when the text is written vertically instead of horizontally.

PR040: An IVS message has a defined priority. The IVS application should respect the priority of IVS messages provided for presentation., such that IVS message whose type is 1 or 2 (primary services) or which are overridden shall have priority for presentation before IVS messages whose type is higher (i.e. greater than 2 – secondary services).

PR050: The HMI should allow the user to know if the IVS service is available or not.

NOTE 2 This is particularly important when the IVS service available has nothing to present to make the distinction between the case the IVS service is not available and the case when the IVS service is available with no information to report.

PR060: The dynamic status of the vehicle should be taken into account before presenting the IVS message. It is up to the receiver ITS-S to decide on whether to transmit information or not to the HMI unit.

EXAMPLE 1 The driver of a vehicle in a traffic jam or on a service area will not need the same information that in a moving vehicle.

PR070: A driver should be able to select a preferred language and national road sign catalogue. If the preferred language or national road sign catalogue does not contain appropriate entries to enable reliable translation of the IVS message content in the preferred choices of the vehicle driver, the information should be presented in the form and language of the IVS sending ITS Station.

PR080: The catalogue in force in a country/region should be downloaded when crossing a border if it is not present in the IVS receiver ITS-S for this specific country/region.

EXAMPLE 2 In case of the European Union, there are 28 official national catalogues.

PR090: The catalogue should include the pictograms of road signs used in the country/region and the reference VMS layout(s) adopted in the considered country/region.

PR100: The HMI should be able to present the different components of a message displayed on a traffic sign or variable message sign as decided by the content provider.

PR110: The corresponding reference layout of VMS content or of a full-matrix sign should be provided.

PR120: This defined priority management only deals with IVS messages. In case of concurrence between different ITS services, the presentation should be carried out according to ISO/TS 16951 specifications.

Annex A
(informative)

Profile 1

A.1 General

ISO standards allow specifying ITS applications agnostic to the communication technology actually used and available. The benefits of the ISO standards (ISO 21217, ISO/TS 17423, ISO 24102-2, ISO 24102-6, ISO/TS 17429…) for IVS and other ITS applications are the following.

— The IVS message can be transmitted using any available communication protocol stack available on the ITS station [ETSI BTP/G5, ISO/P1609 (harmonization on-going), UDP/IP] and thus using any available access technology (vehicular Wi-Fi, urban Wi-Fi, cellular, satellite, infrared, Li-Fi, …).

— The IVS message can be transmitted in different ways, either

  — broadcast from a roadside ITS station to vehicle ITS stations using vehicular Wi-Fi (802.11p),

  — end-to-end from a central ITS station directly to subscribed vehicle ITS stations and personal ITS stations (for instance using the cellular network), and

  — end-to-end from a central ITS station to relay that simply broadcast to vehicle ITS stations and personal ITS stations (e.g. using urban Wi-Fi access points, satellite or digital radio).

— The IVS services can easily be deployed in areas where there is no roadside infrastructure deployed using 802.11p or to drivers who do not yet have an on-board vehicle ITS station equipped with 802.11p.

This Annex specifies a profile for the instantiation of the IVS service largely based on the following standards developed by ISO:

— ISO 21217 for ITS station architecture;

— ISO/TS 17419 for classification and management of ITS applications in a global context;

— ISO/TS 17423 for ITS application requirements for automatic selection of communication interfaces;

— ISO/TS 17429 for ITS station facilities for the transfer of information between ITS stations;

— ISO/TS 18750 for the global concept of local dynamic map;

— CALM standards such as ISO 24102 series.

This Annex describes the following:

— the relationships existing between these different standards (A.2);

— specific additional requirements added to the requirements defined in Clause 7, especially for communications (A.3);

— the functional data model for the IVS service using UML (Annex F);

— the corresponding data dictionary (classes, attributes, and enumerations) (A.5);

— the ASN.1 message structure (A.6 and A.7);

— the normative references used in this Annex.

A.2 Relationship with others standards

The architecture of the ITS station (ITS-S) specified in ISO 21217 is illustrated in Figure A.1.

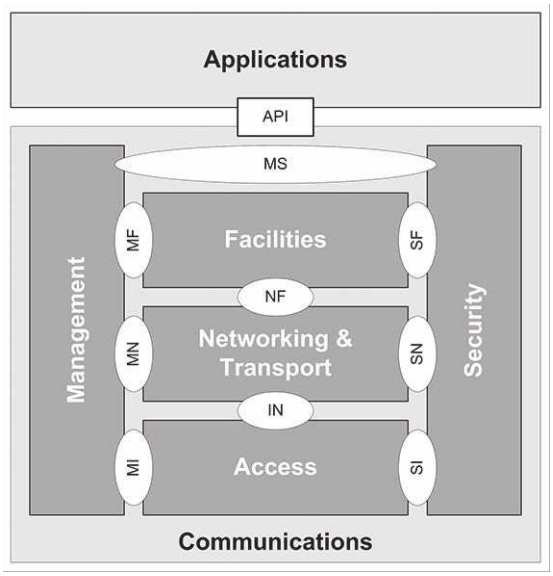


Figure A.1 — Simplified ITS-S reference architecture (from ISO 21217)

The IVS service is provided to users by execution of the IVS application. This application is an instantiation of the IVS service that involves the association of complementary ITS-S application processes.

In order to be able to install and execute these ITS-S application processes in an ITS-S unit (ITS-SU) operated as a Bounded Secured Managed Domain (BSMD) as specified in ISO 21217, the registration procedures identified in ISO/TS 17419 is applied.

The IVS application requires communications between these ITS-S application processes residing in ITS-SU units. Such communications include the exchange of IVS Messages.

In order to enable communications between ITS-S application processes residing in different ITS-S Communication Units (ITS-SCU), prior to transmission of application data units (ADUs) each ITS-S application process registers at the ITS-S management entity and presents its communication requirements as specified in ISO/TS 17423. Required values to be presented for the ITS-S application processes of the IVS application are specified in A.3.5.

Upon this registration and presentation of communication requirements, the ITS-S management will identify the most appropriate communication profile for each source of data and assign a “FlowID” to it as specified in ISO 24102-6.

Communications require features of the ITS-S facilities layer both for transmission and for reception of ADUs as specified in ISO/TS 17429.

The IVS application requires that their related ITS-S application processes provide received geo-referenced and time-stamped information to a Local Dynamic Map (LDM) specified in ISO/TS 18750, when a LDM exists. The LDM is the key element to enable cooperative behaviour in an ITS-SU, i.e. the sharing of data between applications.

The IVS application requires retrieving LDM data elements either by a subscription mechanism or by a query mechanism, as specified in ISO/TS 18750.

The IVS application is uniquely identified by the registered “ITS Application Identifier” (ITS-AID) as specified in ISO/TS 17419.

The IVS application uses predefined messages from the ITS Message Set IVS. The ITS message set IVS is uniquely identified by the registered "ITS Message Set Identifier" (ITS-MsgSetID) specified in ISO/TS 17419. The values of ITS-AID and ITS-MsgSetID are assigned by the respective registration authority. The numbering of messages in this ITS Message Set is as uniquely defined for this IVS Message Set.

A.3 Additional requirements

A.3.1 General requirements

GR050: The In-Vehicle Signage service shall comply with the communications architecture and use of ITS stations as defined in ISO 21217.

A.3.2 Service security requirements

SR010: C-ITS-S and R-ITS-S shall be registered in accordance with the requirements of ISO/TS 17419 to have the right to broadcast IVS messages.

SR020: The ITS-AID (Application Identifier) for this application shall be provided by the registration authority according to ISO/TS 17419.

SR030: IVS messages received by an IVS receiver ITS station shall be safe and secured according to relevant information security standards.

A.3.3 Case of central ITS station

MR270: Except for IVS messages directly generated by a Roadside ITS station, all other IVS message shall be generated by the Content Provider at a Central ITS station and shall be communicated from the Central ITS station to the Roadside ITS station. The Roadside ITS station shall only distribute such a received IVS message once receipt of that IVS message by the Roadside ITS station has been acknowledged towards the originating Central ITS station.

MR280: Except the case where information IVS messages are being created locally by a roadside ITS station, to improve alignment of information provision from multiple sources, central ITS stations(s) shall provide the roadside ITS station with all necessary information related to the IVS application, using the methods specified in ISO/TS 17419.

A.3.4 Message handling using a LDM

If the IVS receiving ITS station uses a LDM specified by ISO/TS 18750, the requirements in this Annex shall apply.

MR290: All IVS messages shall be recorded in the LDM of IVS receiver ITS station according to the specifications of ISO/TS 18750.

MR300: The IVS messages in LDM of IVS receiver ITS station shall be accessed for updating their content according to the specifications of ISO/TS 18750.

MR310: The IVS messages in LDM of IVS receiver ITS station shall be accessed for reading according to the specifications of ISO/TS 18750.

MR320: The IVS messages in the LDM of IVS receiver ITS station shall be deleted according to the specifications of ISO/TS 18750.

A.3.5 Communication requirements

A.3.5.1 Overall and common requirements

The In-Vehicle Signage service, like other ITS services, requires communication between ITS stations. Several communication flow types are identified. Each communication flow type has specific and different communication requirements. These communication requirements shall be provided to the ITS station management entity using the methods specified in ISO/TS 17423 and ISO 24102-6.

Each ITS-S application process shall register at the ITS-S management entity and present its communication requirements as specified in ISO/TS 17423.

The following annexes introduce identified flow types, the actions to be taken by the ITS application processes to provide the requirements and objectives defined below to other ITS-S entities, and the communication values for each flow type.

NOTE This is done for each communication flow type.

A.3.5.2 The different communication flows

IVS requires communication between ITS stations; five communication flow types are identified:

a) flow for high priority broadcast service communication: the roadside ITS-S broadcasts high priority messages to passing IVS receiving ITS stations (e.g. via an IEEE 802. 11p communication interface);

b) flow for low priority broadcast service communication: the roadside ITS-S broadcasts low priority messages to passing IVS receiving ITS station (e.g. via an IEEE 802. 11p communication interface);

c) push service communication flow: the central ITS-S sends point-to-point messages (unicast) to subscribed IVS receiving ITS station application processes (e.g. via a cellular network or an urban WiFi 802.11n communication interface);

d) configuration service communication flow: the roadside ITS-S is managed and configured remotely from the central ITS-S (e.g. via an optic fibre, satellite, or a cellular communication interface);

e) catalogue service communication flow: the central ITS-S sends point-to-point catalogue information (unicast) to subscribed IVS receiving ITS station application processes (e.g. via a cellular network or a DAB/DMB communication interface).

A.3.5.3 ITS-S application process actions

TR010: For each communication flow type, the ITS-S application process shall present its communication requirements and objectives to the ITS-S management entity using the methods described in ISO/TS 17423.

TR020: The minimum dissemination area shall be configured in such a way every receiving ITS-S has reasonable opportunity to receive at least once the corresponding IVS message before it enters or remains in DAZ (or if null or omitted, RZ) of the message during the validity time of the message.

NOTE According to the communication means used, such a requirement will be fulfilled differently.

A.3.5.4 Communication flow type requirements

Table A.1 provides the values of the communication flow requirements for the broadcast service communication flow of the ITS-S application in an R-ITS-S.

Table A.1 — Flow 1. High priority broadcast service communication flow type requirements

Requirement	Value	Comment
Operational Requirements		
LogicalChannelType-Req[a]	SfCH	Safety channel
ContConnect-Req	n.a.	No continuous connectivity
NxRepeat-Req	255, 1s	Repeat at 1 Hz until flow is cancelled or ended
Destination Requirements		
DestinationType-Req	geo-location-based GeoBroadcast	
DestinationDomain-Req	site-local[b]	
CommDistance-Req	n.a.	
Directivity-Req	n.a.	
Performance Requirements		
Resilience-Req	n.a.	
MinThP-Req	n.a.	
MaxLat-Req	n.a.	
MaxADU-Req	<max message size>	
Security Requirements		
Authentication-Req	required	
Encryption-Req	n.a.	
NonRepudiation-Rule	required	
Protocol Requirements		
Protocol-Req	n.a.	

[a] Requirements in bold correspond to mandatory requirements, whereas the others are optional (source: ISO/TS 17423).

[b] See definition in ISO 24102-6 and ISO/TS 17423.

Table A.2 provides the values of the communication flow requirements for the broadcast service communication flow of the ITS-S application in an R-ITS-S.

Table A.2 — Flow 2. Low priority broadcast service communication flow type requirements

Requirement	Value	Comment
Operational Requirements		
LogicalChannelType-Req[a]	SCH	Service channel
ContConnect-Req	n.a.	No continuous connectivity
NxRepeat-Req	255, 1s	Repeat at 1 Hz until flow is cancelled or ended
Destination Requirements		
DestinationType-Req	geo-location-based GeoBroadcast	
DestinationDomain-Req	site-local[b]	
CommDistance-Req	n.a.	
Directivity-Req	n.a.	
Performance Requirements		
Resilience-Req	n.a.	
MinThP-Req	n.a.	

[a] Requirements in bold correspond to mandatory requirements, whereas the others are optional (source: ISO/TS 17423).

[b] See definition in ISO 24102-6 and ISO/TS 17423.

Table A.2 *(continued)*

Requirement	Value	Comment
MaxLat-Req	n.a.	
MaxADU-Req	<max message size>	
Security Requirements		
Authentication-Req	required	
Encryption-Req	n.a.	
NonRepudiation-Rule	required	
Protocol Requirements		
Protocol-Req	n.a.	

[a] Requirements in bold correspond to mandatory requirements, whereas the others are optional (source: ISO/TS 17423).

[b] See definition in ISO 24102-6 and ISO/TS 17423.

Table A.3 provides the values of the communication flow requirements for the push service communication flow of the ITS-S application in a central ITS-S, a vehicle ITS-S, and a personal ITS-S.

Table A.3 — Flow 3. Push service communication flow requirements

Requirement	Value	Comment
Operational Requirements		
LogicalChannelType-Req[a]	GPCH	General purpose channel
ContConnect-Req	n.a.	No continuous connectivity
NxRepeat-Req	n.a.	No repetition
Destination Requirements		
Destination-Type-Req	address-based unicast	
DestinationDomain-Req	global	
CommDistance-Req	n.a.	
Directivity-Req	n.a.	
Performance Requirements		
Resilience-Req	Required	ACK preferred
MinThP-Req	n.a.	
MaxLat-Rea	n.a.	
MaxADU-Req	<max message size>	
Security Requirements		
Authentication-Req	required	
Encryption-Req	n.a.	
NonRepudiation-Rule	required	
Protocol Requirements		
Protocol-Req	n.a.	

[a] Requirements in bold correspond to mandatory requirements, whereas the others are optional (source: ISO/TS 17423).

Table A.4 provides the values of the communication flow requirements for the configuration communication flow of the ITS-S application in a central ITS-S and a roadside ITS-S.

Table A.4 — Flow 4. Configuration flow type requirements

Requirement	Value	Comment
Operational Requirements		
LogicalChannelType-Req[a]	GPCH	General purpose channel
ContConnect-Req	n.a.	No continuous connectivity
NxRepeat-Req	n.a.	No repetition
Destination Requirements		
DestinationType-Req	address-based unicast	
DestinationDomain-Req	global	
CommDistance-Req	n.a.	
Directivity-Req	n.a.	
Performance Requirements		
Resilience-Req	required	ACK preferred
MinThP-Req	n.a.	
MaxLat-Req	n.a.	
MaxADU-Req	<max message size>	
Security Requirements		
Authentication-Req	required	
Encryption-Req	n.a.	
NonRepudiation-Rule	required	
Protocol Requirements		
Protocol-Req	n.a.	

[a] Requirements in bold correspond to mandatory requirements, whereas the others are optional (source: ISO/TS 17423).

Table A.5 provides the values of the communication flow requirements for the catalogue push service communication flow of the ITS-S application in a central ITS-S, a roadside ITS-S, a vehicle ITS-S, and a personal ITS-S.

Table A.5 — Flow 5. Catalogue service communication flow requirements

Requirement	Value	Comment
Operational Requirements		
LogicalChannelType-Req[a]	GPCH	General purpose channel
ContConnect-Req	n.a.	No continuous connectivity
NxRepeat-Req	n.a.	No repetition
Destination Requirements		
Destination-Type-Req	address-based unicast	
DestinationDomain-Req	global	
CommDistance-Req	n.a.	
Directivity-Req	n.a.	
Performance Requirements		
Resilience-Req	Required	ACK preferred
MinThP-Req	n.a.	
MaxLat-Rea	n.a.	

[a] Requirements in bold correspond to mandatory requirements, whereas the others are optional (source: ISO/TS 17423).

Table A.5 *(continued)*

Requirement	Value	Comment
MaxADU-Req	<max message size>	
Security Requirements		
Authentication-Req	required	
Encryption-Req	n.a.	
NonRepudiation-Rule	required	
Protocol Requirements		
Protocol-Req	n.a.	

[a] Requirements in bold correspond to mandatory requirements, whereas the others are optional (source: ISO/TS 17423).

A.4 Conceptual data modelling

A.4.1 General

The following UML diagrams conceptually describe the data exchanged between an information supplier and a receiver. They are defined independently from any physical implementation (platform) and do not preclude communication means. Users not (yet) familiar with UML find a brief introduction in Annex F.

The corresponding elements of the IVS data dictionary can be found in A.5, whereas A.6 contains a simplified tabular description of the different corresponding messages based on this data model. A.7 includes the corresponding ASN.1 definition of these messages.

This conceptual data model described in the following annexes pictures the different classes and attributes necessary to qualify an IVS message that complies with the requirements given in Clause 7. It comprises several packages defined one after the other.

A.4.2 The "IvsPublication" package

A.4.2.1 The class model

The "IvsPublication" package supplies classes and attributes to the definition of the global publication featuring the IVS service, including the common elements and the different types of content. It is pictured including the relationships between the classes in Figure A.2.

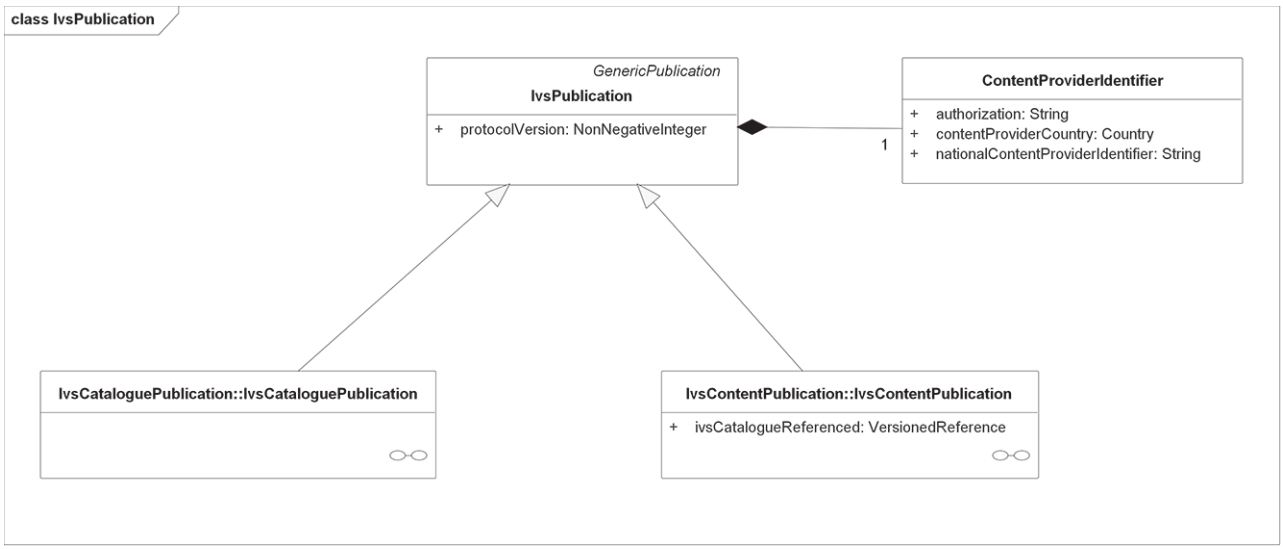


Figure A.2 — "IvsPublication" package

A.4.2.2 Semantics

The most generic concept, i.e. the publication of IVS messages, is a set of one or several contents, each one describing either an element of the used catalogue or a real-world entity considered as a whole: this can be either a physical VMS device or a road sign including panels fixed on a post. This concept is depicted by the "IvsPublication" class that is the main entry point of the corresponding package.

This IVS publication is associated with a content provider who is in charge of providing the IVS content for this publication. This content provider is identified uniquely ("ContentProviderIdentifier" class) in association with a 2-character country code defined according to ISO 3166-1.

A.4.3 The "IvsContentPublication" package

A.4.3.1 The class model

The "IvsContentPublication" package supplies classes and attributes to the definition of the publication featuring the dynamic part of the IVS service, including the common elements and the different types of content. It is pictured including the relationships between the classes in Figure A.3.

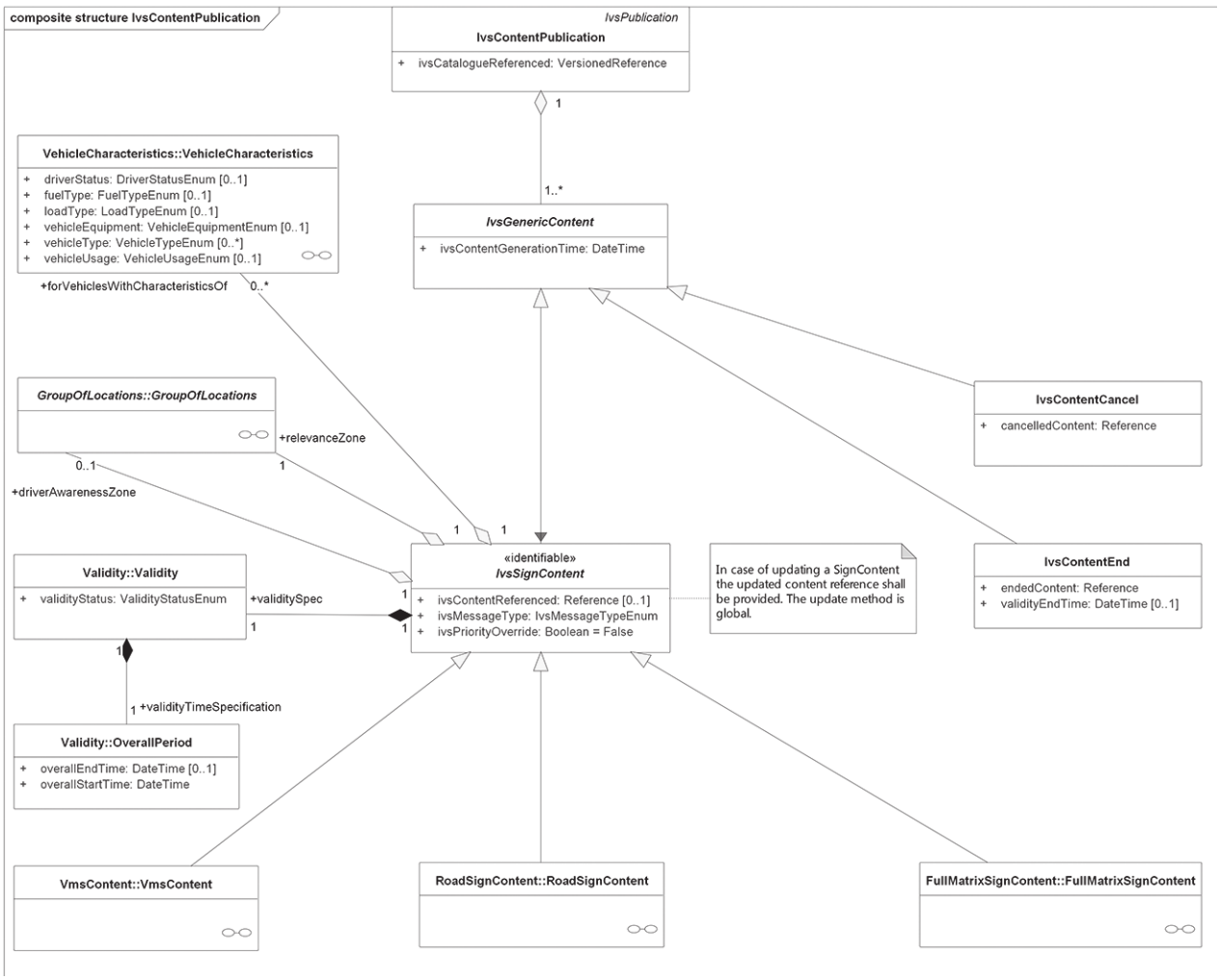


Figure A.3 — "IvsContentPublication" package

A.4.3.2 Semantics

One of the types of "IvsPublication" is used to convey a set of one or several contents, each one describing a real-world entity considered as a whole: this can be either a physical VMS device or a road sign including panels fixed on the same post. This concept is depicted by the "IvsContentPublication" class that is the main entry point of the corresponding package.

The IVS content publication groups together different types of content (generically depicted by the abstract "IvsGenericContent" class), each one associated with a content provider who is identified uniquely and authorized. Each piece of content can be considered as an elementary message.

This content can be either depicted by the abstract "IvsSignContent" class that features the common characteristics of VMS message or of road sign, or by the two ancillary management messages (corresponding to the "IvsContentEnd" and "IvsContentCancel" classes). The "IvsGenericContent" class allows defining the message type in association with its default priority level (see 5.2.3 and 5.2.4) and if the content provider has chosen to override this priority level and thus to give it the top-level priority (attribute "IvsPriorityOverride").

The "IvsSignContent" class is associated with other classes giving information on the vehicle characteristics which the message is valid for. It is also associated with the temporal aspects of the message through the class "Validity" that provide its start time and possibly its end time. The last relationships are with the groups of locations that depict respectively RZ and DAZ. The "IvsSignContent" class is realized with the three "VmsContent", "FullMatrixSignContent", and "RoadSignContent" classes that feature respectively the message associated a physical VMS, a full-matrix sign, and a road sign with its panels fixed on the same post.

The "IvsContentEnd" class is used to provide the validity end of an already distributed message either immediately or at a given date and time of the corresponding attribute is filled in. The "IvsContentCancel" class is used to immediately cancel an already distributed message, i.e. this message is supposed to have never been distributed.

The associated groups of locations featuring RS and DAZ can be either a point, a linear (i.e. an itinerary or a group of non-ordered locations or a single location), or in some specific cases, an area. Different standardized referencing systems can be used for this usage.

A.4.4 The "RoadSignContent" package

A.4.4.1 The class model

The "RoadSignContent" package supplies classes and attributes to the definition of the content of a road signs including possible supplementary panel. It is pictured including the relationships between the classes in Figure A.4.

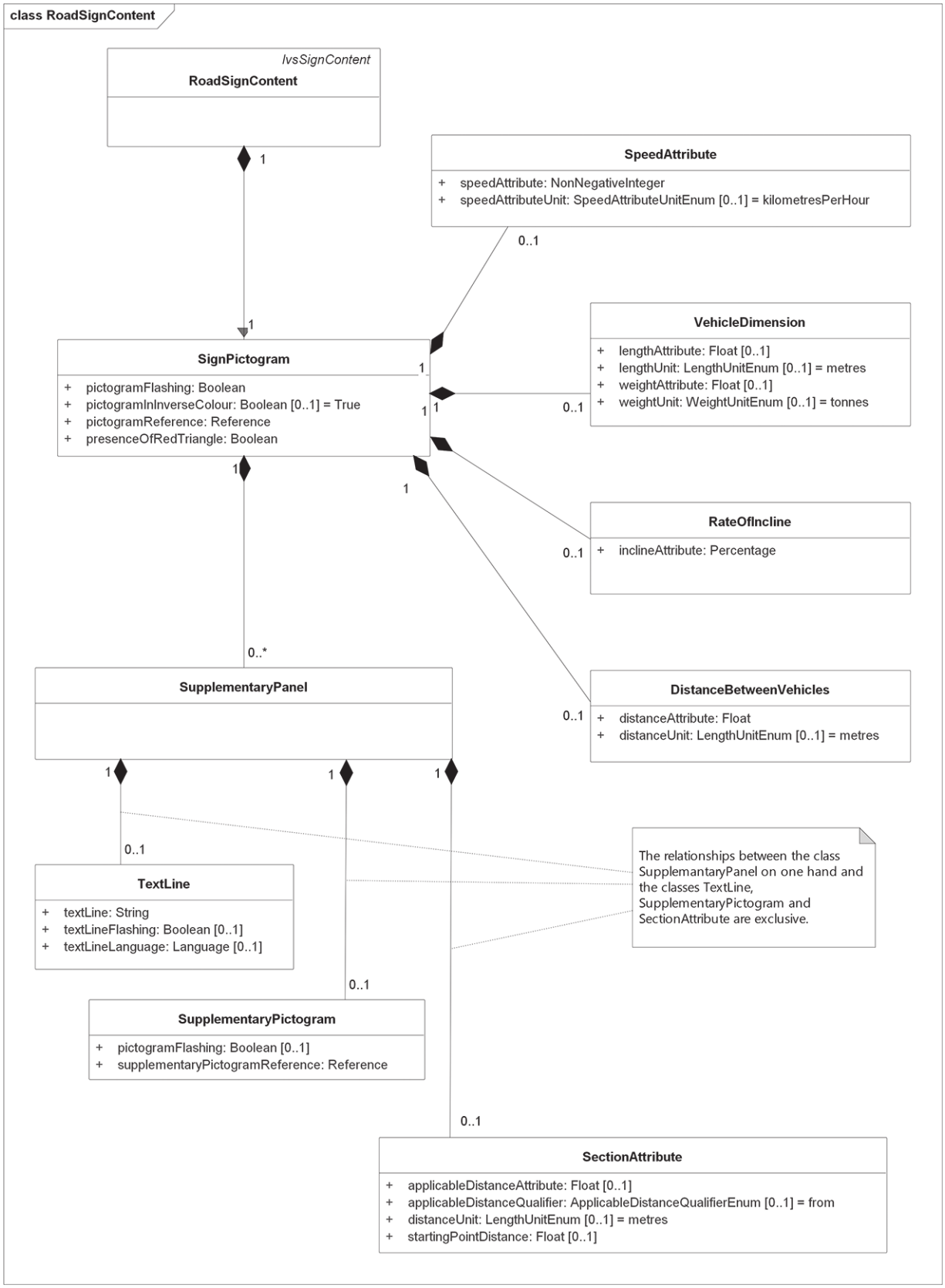


Figure A.4 — "RoadSignContent" package

A.4.4.2 Semantics

The content featured by a road sign accompanied by a potential panel fixed on the same post. The "SignPictogram" class can be used with the "VmsMessage" package.

The "SignPictogram" class can represent either a full-matrix VMS picture provided in content or a pictogram. Complementary attributes provide information related to presentation choices like pictogram flashing or the presence of the red triangle for danger warning signs in countries where this feature is considered.

The "PictogramCode" class is defined according to ISO/TS 14823. The pictogram is defined using the country code of the catalogue, its service category, and the pictogram category. In case this pictogram code is completed by values, several classes define the corresponding attributes. Except for "Percentage", the other attributes should be given with the corresponding unit. In case the attribute unit is not provided, a default value based on international system is used. The attribute classes are the following:

— "SpeedAttribute" for speed limits and advisory speeds;

— "RateOfIncline" for gradient percentages;

— "DistanceBetweenVehicles";

— "VehicleDimension" which groups the different measurement for vehicles.

The "SupplementaryPanel" class shall be completed either with the "TextLine" class, the "SupplementaryPictogram" class (that contains a pictogram suitable for a supplementary panel), or with the "SectionAttribute" class which contains the corresponding distance description.

A.4.5 The "FullMatrixSignContent" package

A.4.5.1 The class model

The "FullMatrixSignContent" package supplies classes and attributes to the definition of the content of a full-matrix VMS. It is pictured including the relationships between the classes in Figure A.5.

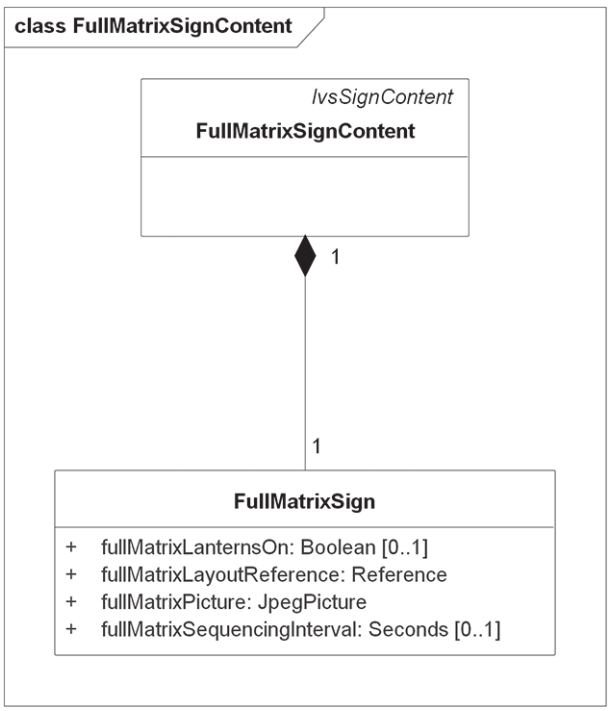


Figure A.5 — "FullMatrixSignContent" package

A.4.5.2 Semantics

The content displayed on a full-matrix VMS is composed of one display unit. If there are several units, these units can be displayed sequentially with a given time interval. It is associated with a reference layout with provides the geometrical characteristics of the corresponding full-matrix VMS used for rendering the message. The displayed picture itself is delivered using a JPEG container.

A.4.6 The "VmsContent" package

A.4.6.1 The class model

The "VmsContent" package supplies classes and attributes to the definition of the content of a VMS. It is pictured including the relationships between the classes in Figure A.6.

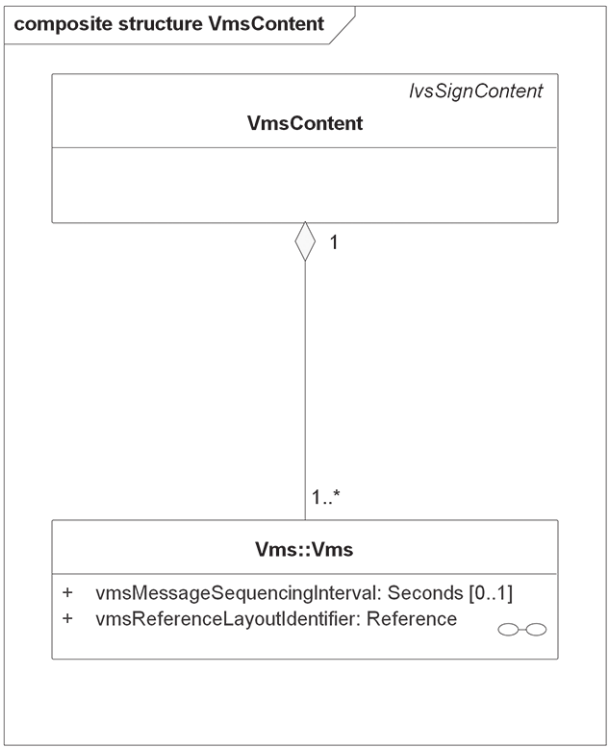


Figure A.6 — "VmsContent" package

A.4.6.2 Semantics

The content displayed on a VMS is composed of one or several displayed units that together form a VMS message. If there are several units, these units can be displayed sequentially with a given time interval. It is associated with a reference layout which provides the geometrical characteristics of the corresponding VMS used for rendering the message.

If the model does allow representing VMS units displayed sequentially on the field, it does not lay down that the HMI unit should render these units using alternate displays.

A.4.7 The "Vms" package

A.4.7.1 The class model

The "Vms" package supplies classes and attributes to the definition of the physical content of a VMS message including its physical characteristics that allow display one VMS message. It is pictured including the relationships between the classes in Figure A.7.

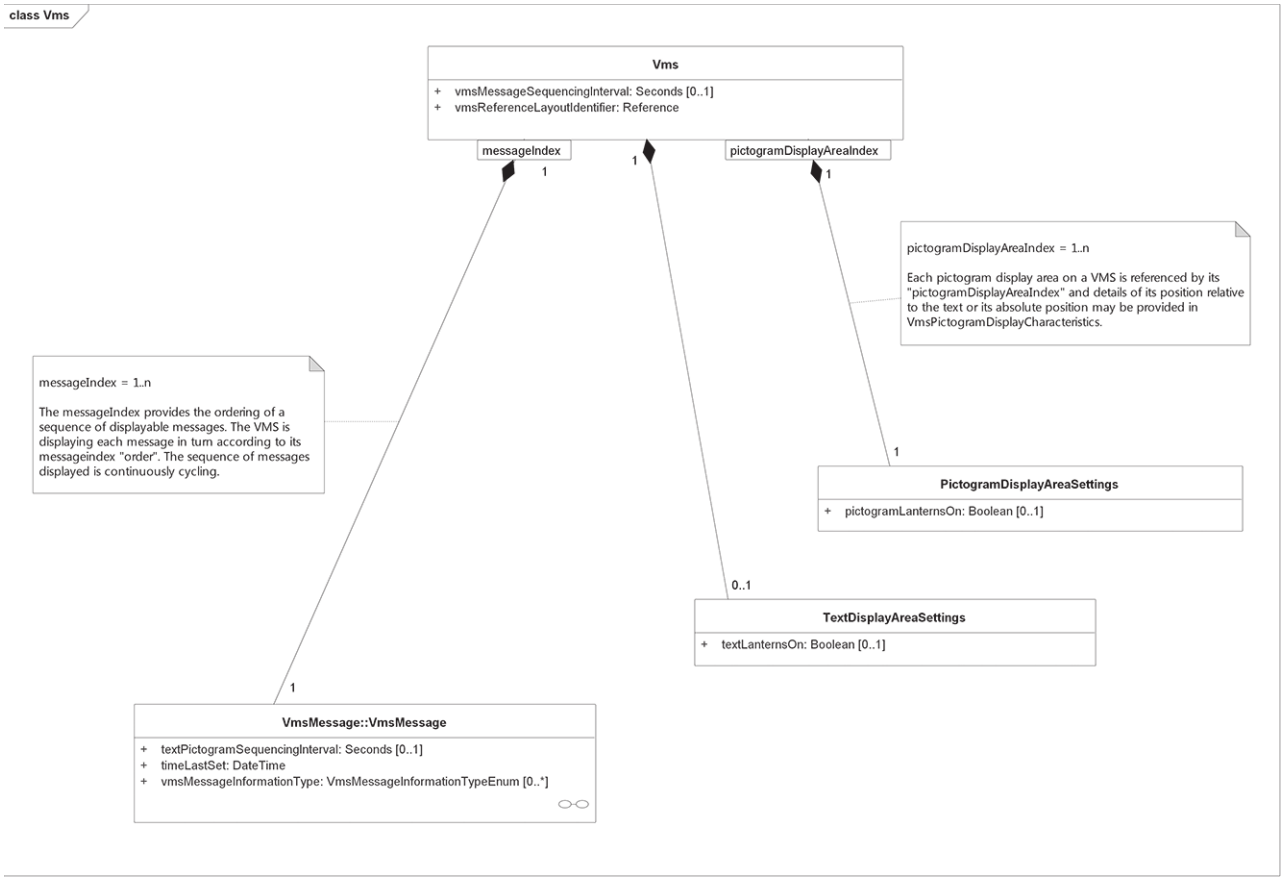


Figure A.7 — "Vms" package

A.4.7.2 Semantics

A single VMS is pictured by an instance of the "Vms" class. It allows a content provider to define what textual legend and pictograms are being displayed, its dynamic characteristics/configuration. A VMS may be set to display a sequence of messages in a defined order where each message comprises a combination of text pages and pictograms. In this case, the "messageIndex" qualifier shall be used to distinguish the individual messages and their order of display.

The settings applicable to the distinct text display area are provided with an instance of the "TextDisplayAreaSettings" class. These settings indicate whether lanterns are on, which are normally independent of the text message currently being displayed. The settings applicable to a distinct pictogram display area are provided with an instance of the "PictogramDisplayAreaSettings" class (referenced by its "pictogramDisplayAreaIndex" qualifier). These settings indicate whether lanterns are on which are normally independent of the pictogram currently being displayed.

A.4.8 The "VmsMessage" package

A.4.8.1 The class model

The "VmsMessage" package supplies classes and attributes to the definition of the logical content of a VMS message where each message shall comprise a combination of one or more text pages and/or one or more pictograms with possible additional supplementary details that qualify the displayed pictogram. Multiple text pages and pictograms shall be sequenced in a specified order and at a specified interval. It is pictured including the relationships between the classes in Figure A.8.

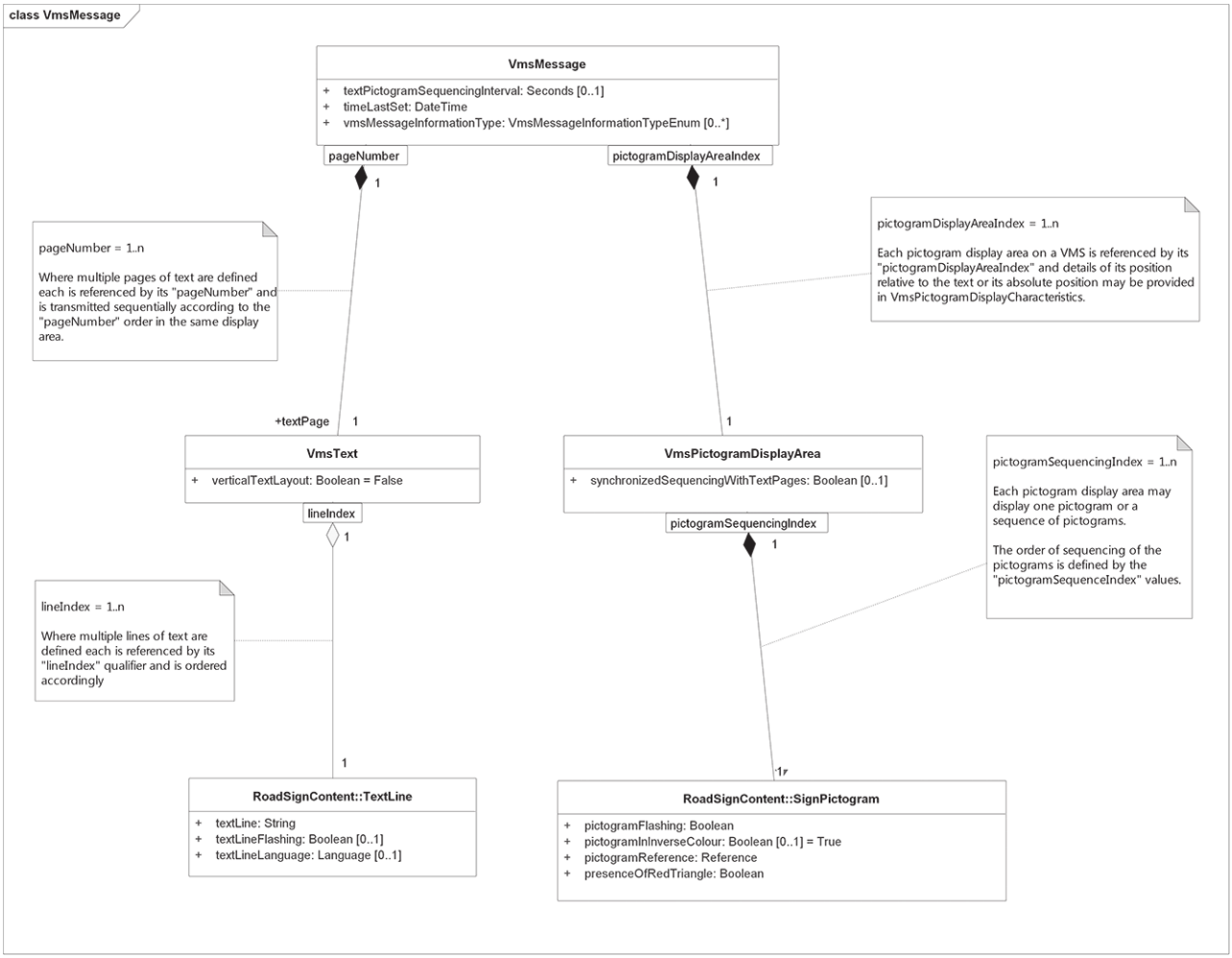


Figure A.8 — "VmsMessage" package

A.4.8.2 Semantics

The "VmsMessage" package pictures a message ("VmsMessage" class) which has a number of indexed components which either model pages of text displayed in a single text display area on the VMS or a number of pictogram display areas on the VMS. Text pages that are displayed on the text display area may be specified as being a set of sequenced pages that are displayed in turn. Similarly, each pictogram display area may be identified as displaying a sequence of separate pictograms. A pictogram display area which is specified as displaying a sequence of pictograms may be specified as having the pictograms sequenced in synchronism with the set of sequenced text pages.

An instance of message ("VmsMessage" class) which is referenced by its "messageIndex" qualifier allows a supplier of information to identify the details of the message currently being displayed on the VMS text display area, the various pictogram display areas and the supplementary panel display areas which may exist to support the pictogram display areas. The "messageIndex" qualifier on the association with the "Vms" class shall indicate the order of display of the messages. If there is only one message being displayed, the "messageIndex" shall have a value of "1".

An instance of the text part ("VmsText" class) allows a content provider to identify what text is displayed in the text display area and what it looks like on the VMS. The "pageNumber" qualifier is used to indicate the sequencing order of the pages of text, the value of "1" indicating the first page of text. Sequencing, if used, is assumed to continuously cycle through the ordered pages of text at a constant rate (the sequencing interval can be specified in the "VmsMessage" class). The attribute "verticalTextLayout" is set when the text is displayed vertically for languages where it is meaningful.

An instance of the text line ("VmsTextLine" class) allows a content provider to identify what text is displayed on a single line in the text display area, or in the supplementary panel area. It also allows the language and the colour of the text line to be specified, and whether it is flashing or has any special formatting applied to it. Each line of text can potentially be in a different language which supports the use of multilingual displays. The "lineIndex" qualifier shall be used to indicate the order of the lines of text, the value of "1" indicating the top or first line of the text.

An instance of pictogram area ("VmsPictogramDisplayArea" class) allows a content provider to associate a pictogram or sequence of pictograms that are being displayed with a specific pictogram display area on the VMS. The attribute "synchronizedSequencingWithTextPages" shall be used to indicate that the sequence of pictograms defined for display on this pictogram display area is sequenced in synchronism with the sequence of text pages on the text display area. If there is a mismatch in the number of text pages and pictograms, the sequences are assumed to resynchronize at the start of each sequence. The "pictogramDisplayAreaIndex" qualifier is used to indicate which pictogram display area is being referenced, the value of "1" indicating the most important pictogram display area.

An instance of pictogram ("SignPictogram" class) allows a content provider to identify the pictogram which is currently displayed or which is in a sequence of pictograms that are currently being displayed in the specified pictogram display area on the VMS. This identification shall be made according to ISO/TS 14823. The "pictogramSequencingIndex" qualifier is used to indicate the order of sequencing of the pictograms, the value of "1" indicating the first pictogram in the sequence. Sequencing, if used, is assumed to continuously cycle through the ordered sequence of pictograms at a constant rate (the sequencing interval can be specified in the "VmsMessage" class). The "SignPictogram" class may be accompanied by the "SupplementaryPictogram" class.

NOTE Sequencing pictograms does not lay down that the HMI unit renders these pictograms with the same mechanism.

A.4.9 The "VehicleCharacteristics" package

A.4.9.1 The class model

The package, "VehicleCharacteristics", supplies classes and attributes for defining the characteristics of vehicles for which an IVS content message is applicable (see Figure A.9). These characteristics include dimensional ones defined as minimum and/or maximum limits.

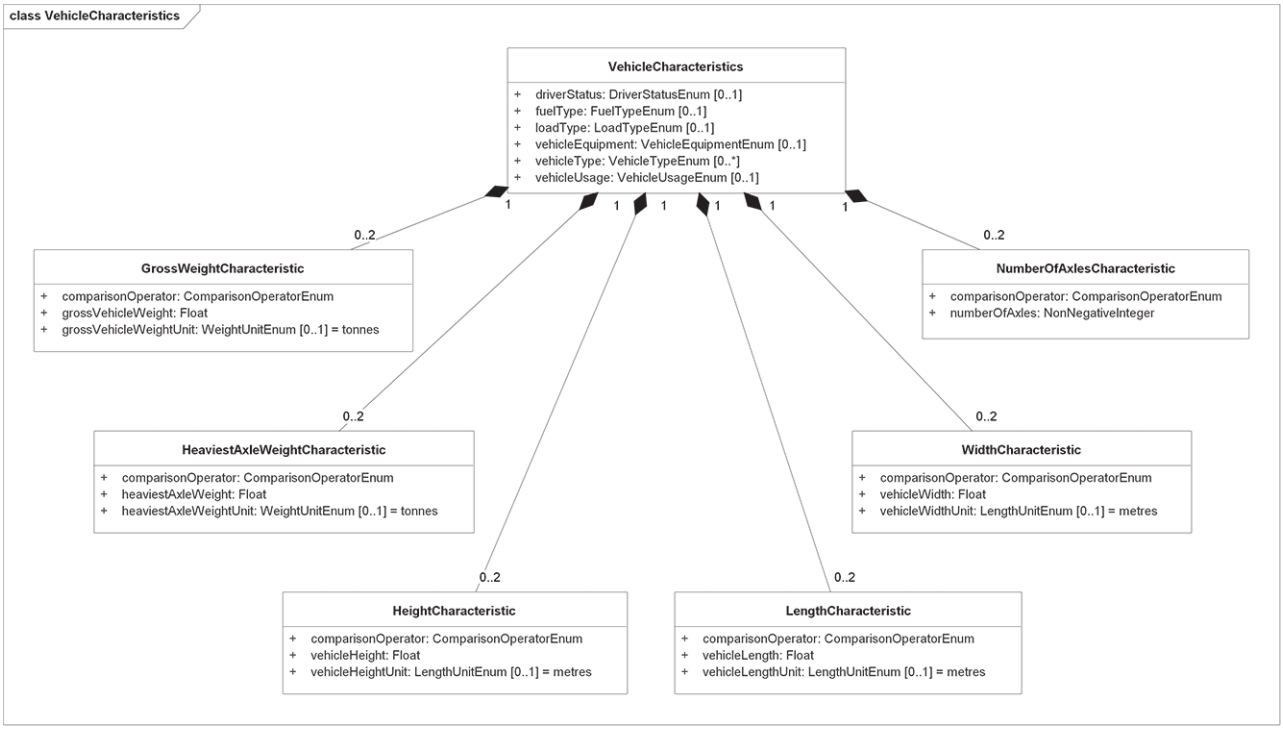


Figure A.9 — "VehicleCharacteristics" package

A.4.9.2 Semantics

The information that is modelled in the "VehicleCharacteristics" package shall identify a set of vehicle characteristics, some of whose values can be specified using comparative operators (e.g. greater than "x" but less than "y"). An instance of the "VehicleCharacteristics" class shall allow a supplier to identify a base set of vehicle characteristics.

The "GrossWeightCharacteristics" class may be used to allow a supplier to identify the actual gross weight of a vehicle. By providing two instances of this class, a supplier can specify the gross weight as being between a lower and upper limit.

The "HeightCharacteristic" class may be used to allow a supplier to identify the actual height of a vehicle. By providing two instances of this class, a supplier can specify the height as being between a lower and upper limit.

The "LengthCharacteristic" class may be used to allow a supplier to identify the actual length of a vehicle. By providing two instances of this class, a supplier can specify the length as being between a lower and upper limit.

The "WidthCharacteristic" class may be used to allow a supplier to identify the actual width of a vehicle. By providing two instances of this class, a supplier can specify the width as being between a lower and upper limit.

The "HeaviestAxleWeightCharacteristic" class may be used to allow a supplier to identify the actual heaviest axle weight of a vehicle. By providing two instances of this class, a supplier can specify the heaviest axle weight as being between a lower and upper limit.

The "NumberOfAxlesCharacteristic" class may be used to allow a supplier to identify the actual number of axles on a vehicle. By providing two instances of this class, a supplier can specify the number of axles as being between a lower and upper limit.

A.4.10 The “IvsCataloguePublication” package

A.4.10.1 The class model

The “IvsCataloguePublication” package supplies classes and attributes to the definition of the publication featuring the static part of the IVS service, including the common elements and the different types of reference data. It is pictured including the relationships between the classes in Figure A.10.

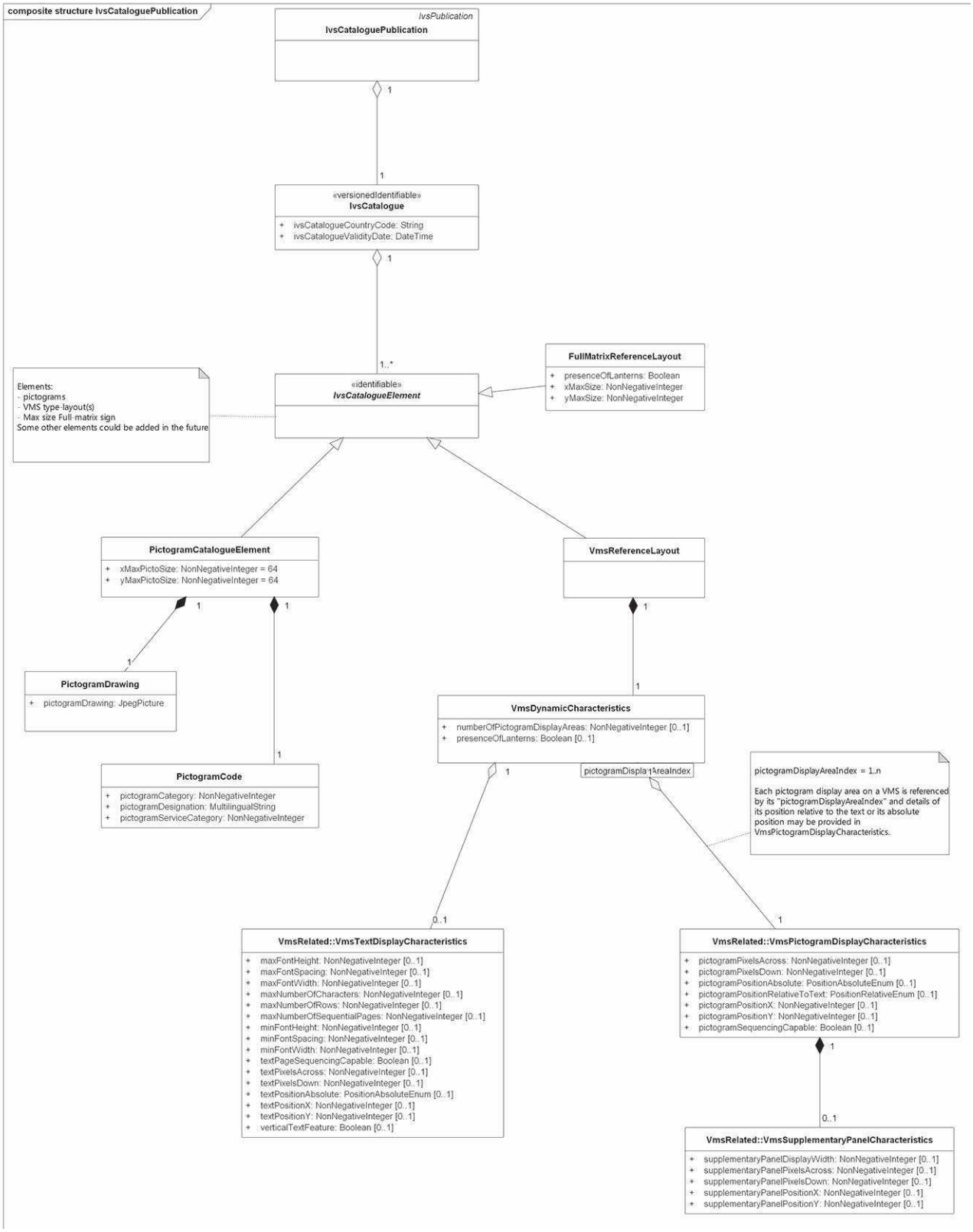


Figure A.10 — "IvsCataloguePublication" package

A.4.10.2 Semantics

One of the types of "IvsPublication" is used for conveying catalogue contents used as static reference data used together with the "IvsContentPublication" class.

This publication has a threefold usage:

a) the provision of (updated) pictogram catalogues for one country/region;

b) the provision of the reference layout for VMS in one country/region used for rendering VMS content message;

c) the provision of the physical characteristics of full-matrix signs used in one country/region.

The dynamic characteristics of a VMS are provided with an instance of the "VmsDynamicCharacteristics" class. The characteristics for each pictogram display area shall be referenced by the area's "pictogramDisplayAreaIndex" qualifier which provides a semantic indication of the importance of the pictogram display area ("1" indicating the highest importance) as perceived by the content provider.

The text display characteristics currently being used on the VMS are provided with an instance of the "VmsTextDisplayCharacteristics" class". The attribute "textPageSequencingCapable" may be used to provide an indication of whether the VMS is capable of displaying a number of text pages which are automatically displayed in a defined sequence and at a defined rate, whereas the attribute "verticalTextFeature" may be used to provide an indication of whether the VMS is capable of displaying text vertically for languages where it is relevant.

The pictogram display characteristics currently being used on the VMS are provided with an instance of the "VmsPictogramDisplayCharacteristics" class. The attribute "pictogramSequencingCapable" may be used to provide an indication of whether the VMS is capable of displaying a number of separate pictograms which are automatically displayed in a defined sequence and at a defined rate. Each pictogram display area may have associated with it a maximum of one supplementary panel for displaying additional details or regulatory instructions. Supplementary panels are managed as part of the pictogram display area that they support. The supplementary panel display characteristics currently being used on the VMS are provided with an instance of the "VmsSupplementaryPanelCharacteristics" class.

A.4.11 Element catalogues

A.4.11.1 General

This subclause describes the different data element catalogue which may be used by IVS services.

A.4.11.2 The "Generic" data type package

A.4.11.2.1 The class model

The following package (pictured in Figure A.11) describes the different generic data types used by the IVS service.

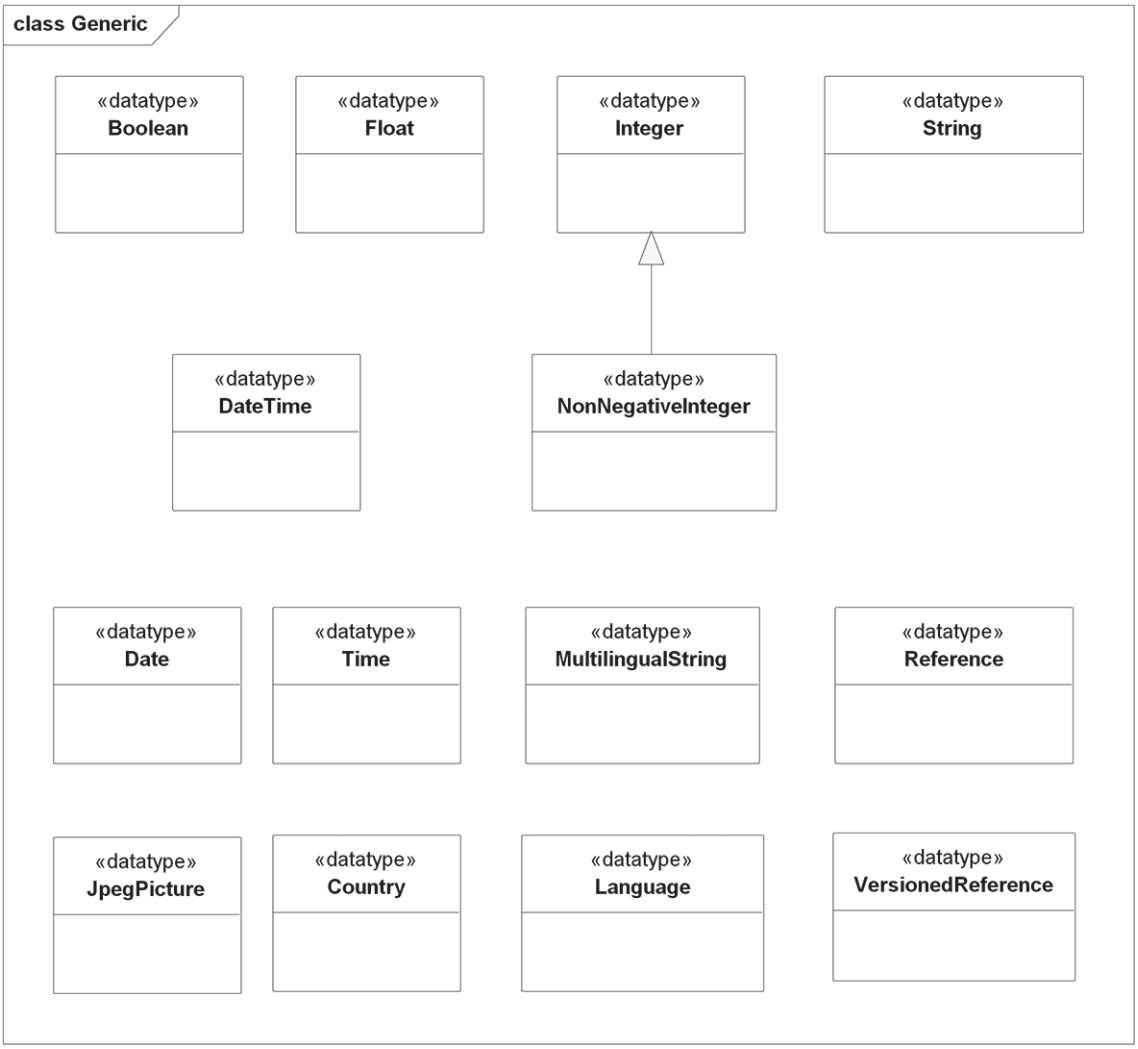


Figure A.11 — "Generic" package

A.4.11.2.2 Semantics

Specific data types are explained below.

— The data type "MultingualString" is a representation of a string, whereby the same text may be expressed in more than one language.

— The data type "Reference" represents a reference to an identifiable managed object where the identifier is unique. It comprises an identifier (e.g. GUID) and a string identifying the class of the referenced object.

— The data type "VersionedReference" represents a reference to an identifiable version managed object where the combination of the identifier and version is unique. It comprises an identifier (e.g. GUID), a version (NonNegativeInteger) and a string identifying the class of the referenced object.

— The data type "Language" allows identification of a specified language by an ISO 639-1 2-alpha code.

— The data type "Country" allows identification of a specified country by an ISO 3166-1 2-alpha code.

— The data type "JpegPicture" represents a container capable of conveying any JPEG-encoded picture.

A.4.11.3 The "Specific" data types package

A.4.11.3.1 The class model

The following package (pictured in Figure A.12) describes the different specific data types used by the IVS service.

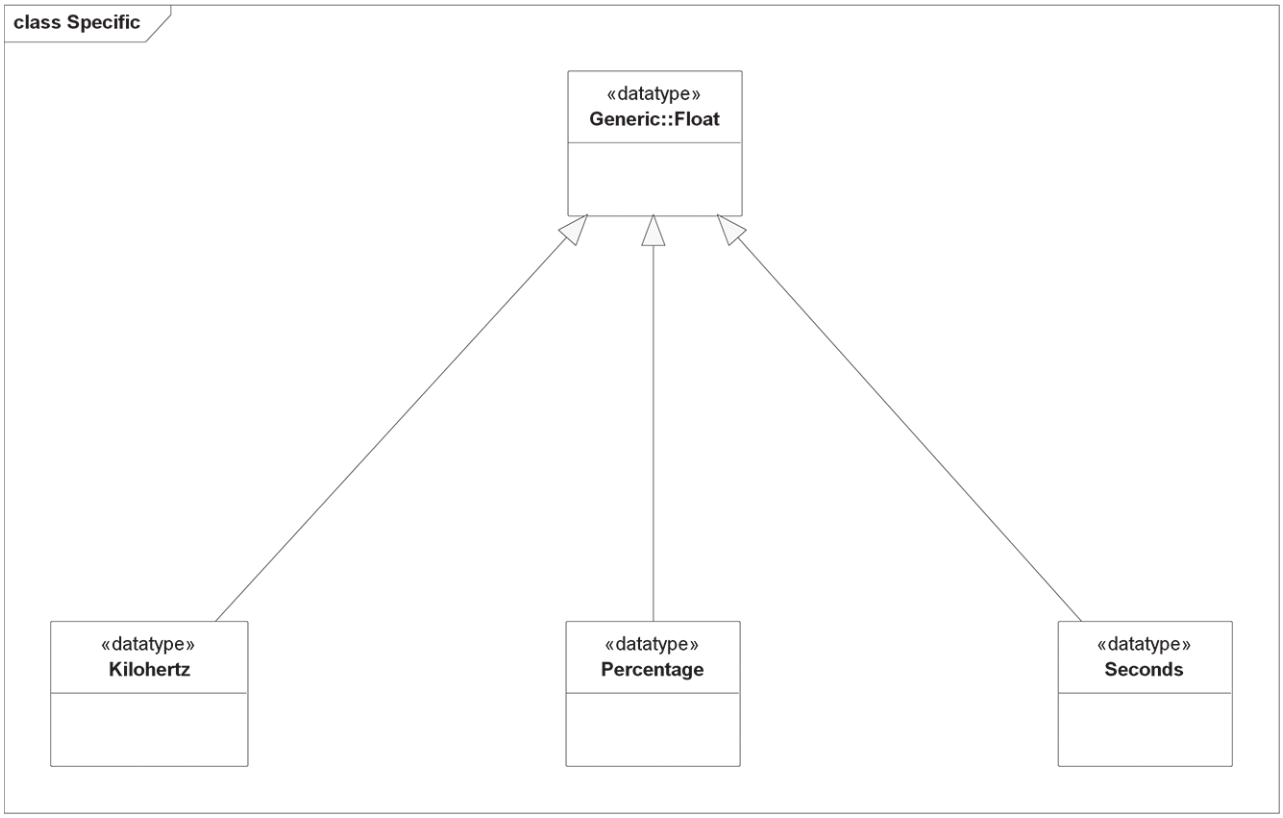


Figure A.12 — "Specific" package

A.4.11.3.2 Semantics

These data types are derived from the generic "Float" data type. They allow definition of measures associated with a measure unit.

A.4.11.4 The IVS enumerations

The following "IvsEnumerations" package provides a synthetic view of the different enumerations used by the IVS service. It is pictured in Figure A.13.

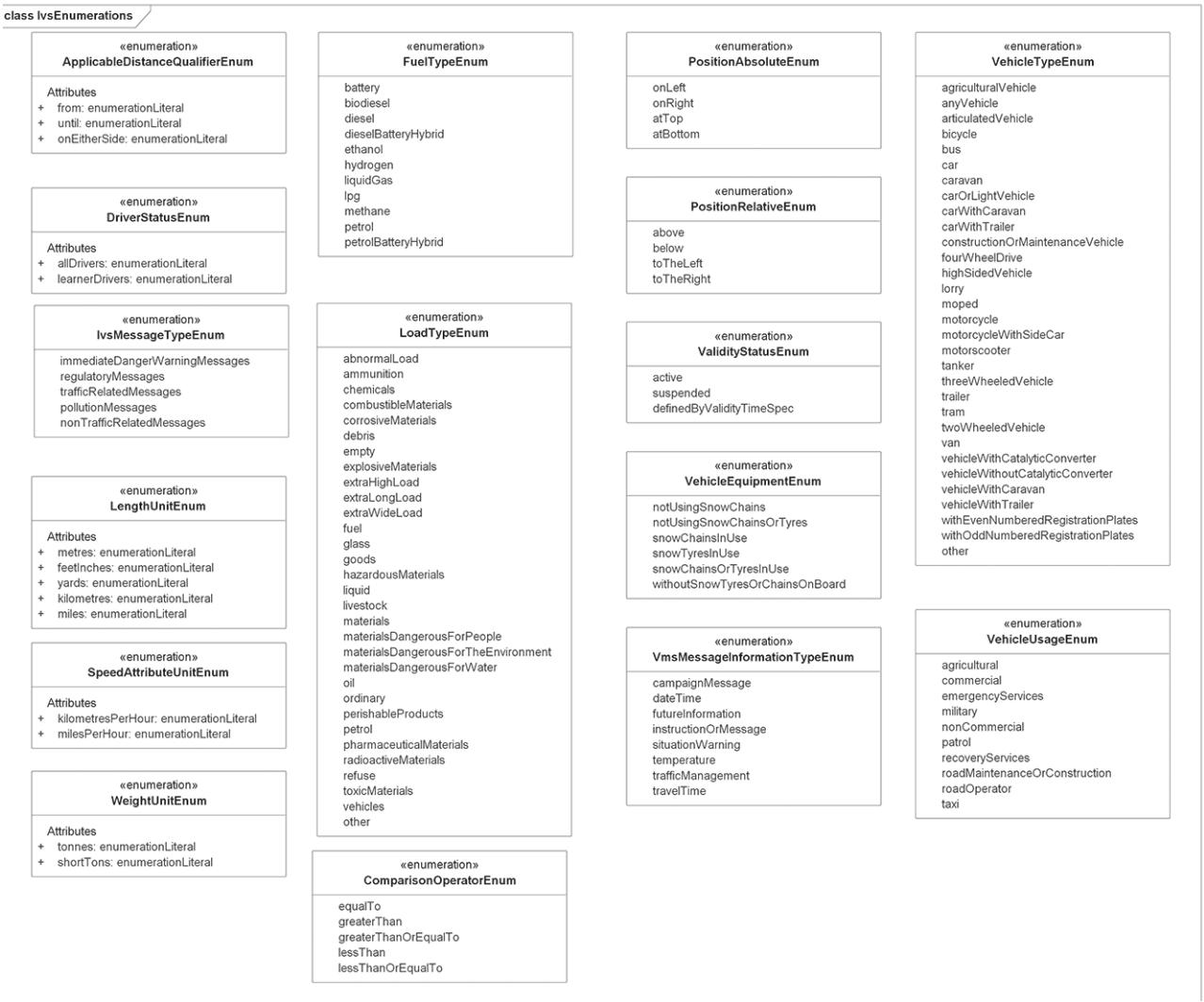


Figure A.13 — "IvsEnumerations" package

A.5.4 provides the numeric values and the corresponding definitions for each enumeration literal.

A.4.12 Update of reference data

The reference data of an ITS station shall be updated regularly on a national/regional basis and every time the ITS station crosses a national/regional border and the corresponding catalogue is not available. This is achieved through the "IvsCataloguePublication" publication (see A.4.10).

Two methods are defined.

— A broadcast method when the catalogue update information is unilaterally pushed to receiving ITS-S (e.g. when crossing a country border to download the national catalogue). The corresponding sequence diagram is defined in Figure A.14.

— A pull method when the receiving ITS-S asks the content provider whether a new version is available. If available, the new catalogue publication is sent to the IVS-S, otherwise the current version confirmation is sent. The corresponding sequence diagram is defined in Figure A.15.

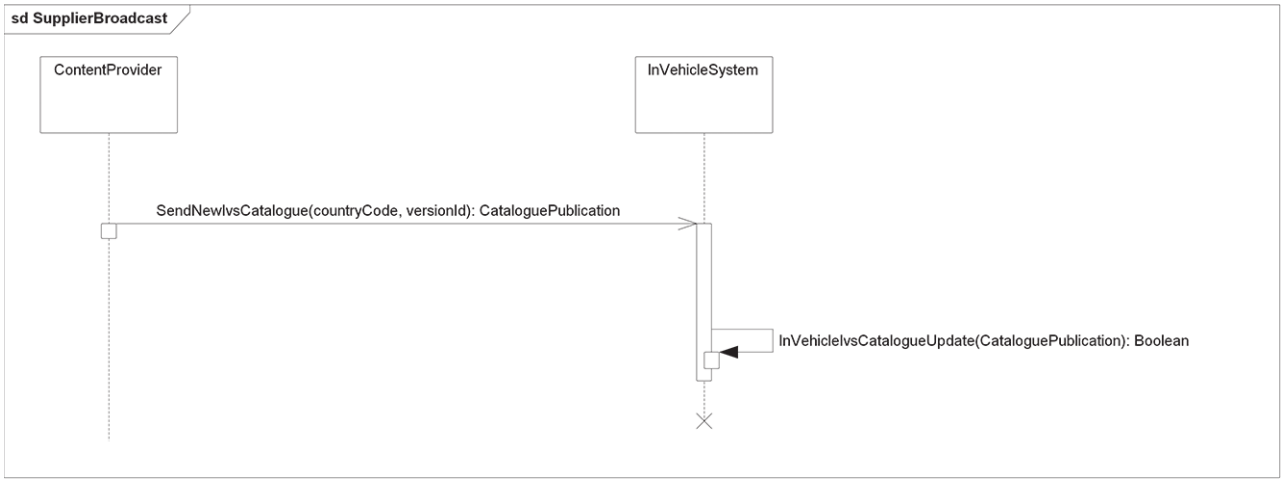


Figure A.14 — "SupplierBroadcast" sequence diagram

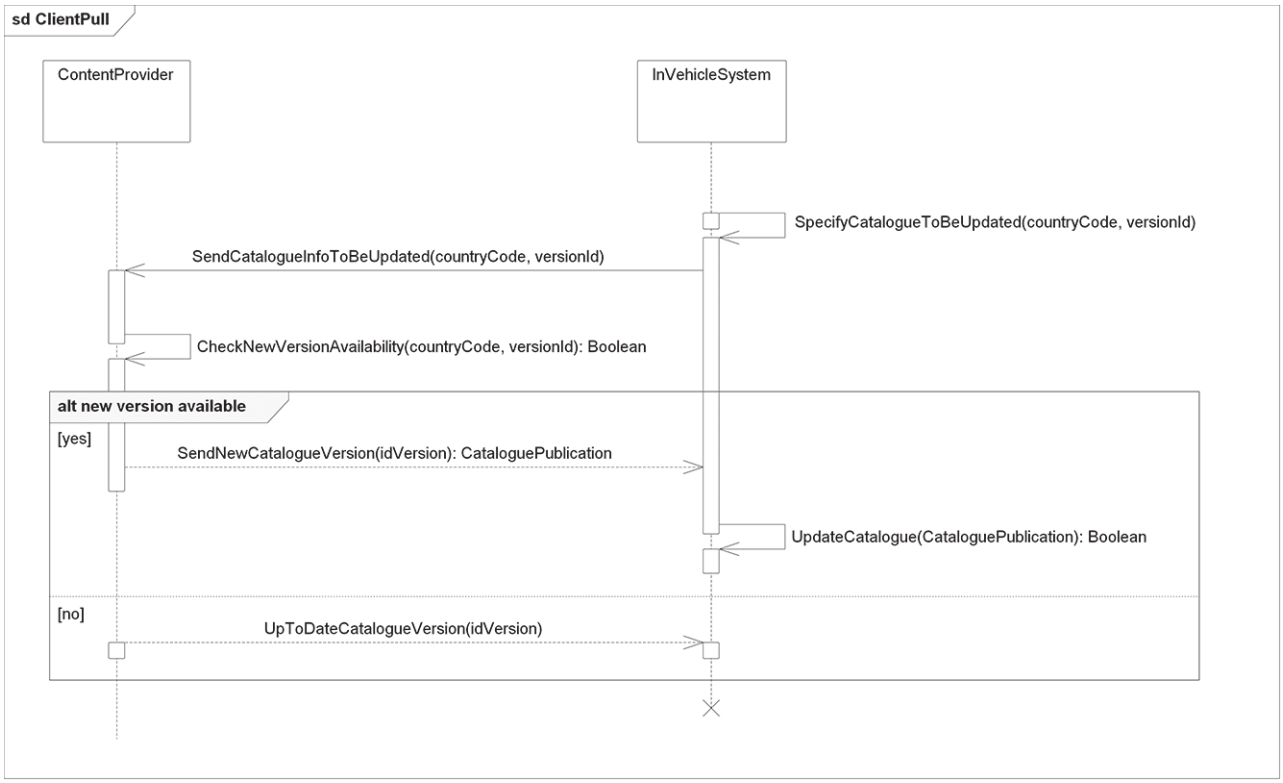


Figure A.15 — "ClientPull" sequence diagram

A.5 Elements of IVS dictionary

A.5.1 Overview

This data dictionary identifies the definitions and characteristics of the different classes, attributes, association roles, data types, and enumerations appearing in the data model defined in this Annex. The data dictionary is specified in three parts, one for packages, one for <<datatypes>> and one for <<enumerations>>, each ordered alphabetically (except for enumeration values that are ordered following their numeric equivalent).

The first part of the data dictionary for each publication is partitioned into subclauses which relate to each of the UML model packages and each subclause defines the contained classes, their attributes, and any roles defined for associations between the classes within that package.

The Data Dictionary tables use the following columns:

a) Column **Class name**: It provides the symbolic name (Upper Camel Case) given to the corresponding class.

b) Column **Role name**: It provides the symbolic name (Lower Camel Case) given to the corresponding role of an association.

c) Column **Attribute name**: It provides the symbolic name (Lower Camel Case) given to the corresponding attribute of a class.

d) Column **Enumerated value name**: It provides the symbolic name (Lower Camel Case) given to the corresponding enumerated value.

e) Column **Integer value**: It provides the integer value equivalent to the symbolic name of an enumerated value name.

f) Column **Designation**: It provides the corresponding name in natural language of the corresponding class, attribute, role, or enumeration value.

g) Column **Definition**: It provides a comprehensive definition detailing the class, attribute, or role.

h) Column **Stereotype**: It provides a statement of the stereotype that is assigned to the class, if any.

i) Column **Abstract**: It provides a statement as to whether the class is abstract (non-realizable) or concrete (realizable).

j) Column **Multiplicity**: It provides a statement of the allowed multiplicity for the attribute or role.

k) Column **Target**: It provides the name of the class which is at the end of the association to which the role applies.

l) Column **Type**: It provides the name of the class used to define the data type relating to the attribute of the class.

A.5.2 Definition of the packages, classes and relationships

A.5.2.1 "FullMatrixSignContent" package

A.5.2.1.1 "FullMatrixSignContent" package classes

Table A.6 — Classes of the "FullMatrixSignContent" package

Class name	Designation	Definition	Stereotype	Abstract
FullMatrixSign	Full-matrix sign	The corresponding message that is displayed on a full-matrix sign. A full-matrix sign is a characteristic-specific VMS where each pixel is independently controlled.		no
FullMatrixSignContent	Full-matrix sign content	Provides the content that is displayed on a full-matrix sign including its highlighting. A full-matrix sign is a technology-specific VMS where pixel is separately controlled.		no

A.5.2.1.2 "FullMatrixSignContent" package association roles

There are no defined association roles in the "FullMatrixSignContent" package.

A.5.2.1.3 "FullMatrixSignContent" package attributes

Table A.7 — Attributes of the "FullMatrixSignContent" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
FullMatrixSign	fullMatrixLanternsOn	Full-matrix lanterns on	The default language used throughout the payload publication.	0..1	Boolean
	fullMatrixLayoutReference	Full-matrix layout reference	Version of the IVS protocol.	1..1	Reference
	fullMatrixPicture	Full-matrix picture	Date/time at which the payload publication was created.	1..1	JpegPicture
	fullMatrixSequencingInterval	Full-matrix sequencing interval	Information about authentication/authorization of the content provider.	0..1	Seconds

A.5.2.2 "IvsCataloguePublication" package

A.5.2.2.1 "IvsCataloguePublication" package classes

Table A.8 — Classes of the "IvsCataloguePublication" package

Class name	Designation	Definition	Stereotype	Abstract
FullMatrixReferenceLayout	Full-matrix reference layout	An element of an IVS catalogue describing pictograms, reference VMS layout, or reference full-matrix sign.		no
IvsCatalogue	IVS catalogue	A collection of static elements used for rendering a road sign or a VMS.	versionedIdentifiable	no
IvsCatalogueElement	IVS catalogue element	An element of an IVS catalogue describing pictograms, reference VMS layout, or reference full-matrix sign.	identifiable	yes
IvsCataloguePublication	IVS catalogue publication	A publication allowing exchanging of updating the content catalogue of one or more road sign and/or variable message signs.		no
PictogramCatalogueElement	Pictogram catalogue element	An element of an IVS catalogue describing pictograms used on road sign or VMS.		no
PictogramCode	Pictogram code	Collection of attributes describing a road sign pictogram.		no
PictogramDrawing	Pictogram drawing	A JPEG-file picturing a road pictogram.		no
VmsDynamicCharacteristics	VMS dynamic characteristics	Provides the current characteristic settings for the VMS which can be dynamically configured.		no
VmsReferenceLayout	Vms reference layout	A catalogue element picturing a VMS layout used for rendering VMS messages.		no

A.5.2.3 "IvsCataloguePublication" package association roles

There are no defined association roles in the "IvsCataloguePublication" package.

A.5.2.4 "IvsCataloguePublication" package attributes

Table A.9 — Attributes of the "IvsCataloguePublication" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
FullMatrixReferenceLayout	presenceOfLanterns	Presence of lanterns	Indicates whether the VMS is equipped with flashing lanterns associated with the full-matrix sign area.	0..1	Boolean
	xMaxSize	X max size	Maximum horizontal dimension of a full-matrix sign (in pixels).	1..1	NonNegativeInteger
	yMaxSize	Y max size	Maximum vertical dimension of a full-matrix sign (in pixels).	1..1	NonNegativeInteger
IvsCatalogue	catalogueCountryCode	Catalogue country code	ISO 3166-1 two character country code of the catalogue.	1..1	Country
	catalogueValidityDate	Catalogue validity date	The date and time from which the IVS catalogue is valid.	1..1	DateTime
PictogramCatalogueElement	xMaxPictoSize	X max picto size	The maximum horizontal pictogram size (in pixels).	1..1	NonNegativeInteger
	yMaxPictoSize	Y max picto size	The maximum vertical pictogram size (in pixels).	1..1	NonNegativeInteger
PictogramCode	pictogramCategory	Pictogram category	The corresponding category number of the considered pictogram under the service category encoded according to ISO/TS 14823.	1..1	NonNegativeInteger
	pictogramDesignation	Pictogram designation	The corresponding pictogram definition expressed in a natural language.	1..1	MultilingualString
	pictogramServiceCategory	Pictogram service category	Code number assigned to the category of elements grouping several pictogram categories, encoded according to ISO/TS 14823.	1..1	NonNegativeInteger
PictogramDrawing	pictogramDrawing	Pictogram drawing	The byte stream corresponding to the JPEG-formatted pictogram picture.	1..1	JpegPicture
VmsDynamicCharacteristics	numberOfPictogramDisplayAreas	Number of pictogram display areas	Number of pictogram display areas which the VMS contains.	0..1	NonNegativeInteger
	presenceOfLanterns	Presence of lanterns	Indicates whether the VMS is equipped with flashing lanterns.	0..1	Boolean

A.5.2.5 "IvsContentPublication" package

A.5.2.5.1 "IvsContentPublication" package classes

Table A.10 — Classes of the "IvsContentPublication" package

Class name	Designation	Definition	Stereotype	Abstract
IvsContentCancel	IVS content cancel	Message related to a road sign or VMS content message in order to cancel it (with immediate effect).		no
IvsContentEnd	IVS content end	Message related to a road sign, full-matrix sign, or VMS content message in order to end the previously identified content. If no date and time information is provided, the ending effect is immediate.		no
IvsContentPublication	IVS content publication	A payload publication of In-Vehicle Signage content information created at a specific point in time that can be exchanged.		no
IvsGenericContent	IVS generic content	Generic class from which the different IVS contents are derived.		no
IvsSignContent	IVS sign content	Provides the general characteristics of a VMS content or road sign.	identifiable	yes

A.5.2.5.2 "IvsContentPublication" package association roles

Table A.11 — Associations of the "IvsContentPublication" package

Class name	Role name	Designation	Definition	Multiplicity	Target
SignContent	driverAwarenessZone	Driver awareness zone	The group of locations representing the driver awareness zone associated to the sign content.	0..1	GroupOfLocations
	forVehiclesWithCharacteristicsOf	For vehicles with characteristics of		0..1	VehicleCharacteristics
	relevanceZone	Relevance zone	The group of locations representing the relevance zone associated to the sign content.	1..1	GroupOfLocations
	validitySpec	Validity spec		1..1	Validity

A.5.2.5.3 "IvsContentPublication" package attributes

Table A.12 — Attributes of the "IvsContentPublication" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
IvsContentCancel	cancelledContent	Cancelled content	The reference of the SignContent class instance to be cancelled.	1..1	Reference
IvsContentEnd	endedContent	Ended content	A reference to the SignContent class instance to be ended.	1..1	Reference
	validityEndTime	Validity end time	A date/time at which the SignContent class instance is ended. If it is not provided, the ending effect is immediate.	0..1	DateTime
IvsContentPublication	ivsCatalogueReferenced	IVS catalogue referenced	The reference (including version) of the corresponding catalogue from which entities for rendering are drawn.	1..1	VersionedReference

Table A.12 *(continued)*

Class name	Attribute name	Designation	Definition	Multiplicity	Type
IvsGeneric-Content	ivsContentGener-ationTime	IVS content gen-eration time	The date/time the IVS content element was generated by the IVS content provider at.	1..1	DateTime
IvsSignContent	ivsContentRefer-enced	IVS content refer-enced	A reference to the SignContent class instance which is updat-ed by the current content in-stance. This is only provided in case of a sign element update.	0..1	Reference
	ivsMessageType	IVS message type	The message type correspond-ing to the priority level as defined in 5.2.	1..1	IvsMessa-geTypeE-num
	ivsPriorityOver-ride	IVS priority override	Overrides for this single IVS message content the priority value defined by default ac-cording to the message type by allocating the highest priority. True means the default priori-ty is overridden.	1..1	Boolean

A.5.2.6 "IvsPublication" package

A.5.2.6.1 "IvsPublication" package classes

Table A.13 — Classes of the "IvsPublication" package

Class name	Designation	Definition	Stereotype	Abstract
IvsPublication	IVS publication	Information about a fault relating to a specific piece of equipment or process.	identifiable	yes
ContentProvid-erIdentifier	Content provider identifier	Details of the fault which is being reported for the specified variable message sign panel.		no

A.5.2.6.2 "IvsPublication" package association roles

There are no defined association roles in the "IvsPublication" package.

A.5.2.6.3 "IvsPublication" package attributes

Table A.14 — Attributes of the "IvsPublication" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
IVS publica-tion	defaultLanguage	Default language	The default language used throughout the IVS publication.	1..1	Language
	protocolVersion	Protocol version	Version of the IVS protocol.	1..1	NonNega-tiveInteger
	publicationTime	Publication time	Date/time at which the IVS publication was created.	1..1	DateTime

Table A.14 *(continued)*

Class name	Attribute name	Designation	Definition	Multiplicity	Type
Content-ProviderI-dentifier	authorization	Authorization	Information about authenti-cation/authorization of the content provider	1..1	String
	content-ProviderCountry	Content provid-er country	ISO 3166-1 two character country code of the content provider.	1..1	Country
	nationalCon-tentProviderI-dentifier	National con-tent provider identifier	An identifier/name whose range is specific to the par-ticular country.	1..1	String

A.5.2.7 "RoadSignContent" package

A.5.2.7.1 "RoadSignContent" package classes

Table A.15 — Classes of the "RoadSignContent" package

Class name	Designation	Definition	Stereotype	Abstract
DistanceBe-tweenVehicles	Distance be-tween vehicles	Provides the distance value displayed on the corresponding road sign.		no
RateOfIncline	Rate of incline	Provides the ramp percentage displayed on the road sign.		no
RoadSignCon-tent	Road sign con-tent	A message content containing the current status and settings of one road sign on a post.		no
SectionAttrib-ute	Section attrib-ute	Provides the applicable distance or distance at which the road sign is applicable.		no
SignPictogram	Sign pictogram	A main pictogram displayable on the VMS panel. Note that a main pictogram may have an asso-ciated supplementary panel which may itself contain a further pictogram and line of text.		no
SpeedAttribute	Speed attribute	Provides the speed value displayed on the corre-sponding road sign.		no
VehicleDimen-sion	Vehicle dimen-sion	Provides the vehicle dimension (weight or length) displayed on the corresponding road sign.		no
Supplementa-ryPanel	Supplementary panel	A panel which may display information or a regulatory instruction which is supplemental to the associated pictogram, comprising either an additional line of text or a pictogram or both.		no
Supplementa-ryPictogram	Supplementary pictogram	An additional pictogram that is displayed in the panel which is supplemental to the associated pictogram display.		no
VmsTextLine	VMS text line	A single line of text on a text display area or sup-plementary panel.		no

A.5.2.7.2 "RoadSignContent" package association roles

There are no defined association roles in the "RoadSignContent" package.

A.5.2.7.3 "RoadSignContent" package attributes

Table A.16 — Attributes of the "RoadSignContent" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
DistanceBetweenVehicles	distanceAttribute	Distance attribute	Value of distance that is displayed as part of the pictogram (e.g. for keep minimum safe distance).	1..1	Float
	distanceUnit	Distance unit	Length unit used for the distance value.	0..1	LengthUnitEnum
RateOfIncline	inclineAttribute	Incline attribute	Value of the ramp given on the road sign (uphill or downhill).	1..1	Percentage
SectionAttribute	applicableDistanceAttribute	Applicable distance attribute	The applicable distance for the prescription of the danger warning (it defines the relevance zone in simple cases).	0..1	Float
	applicableDistanceQualifier	Applicable distance qualifier	Indicates how the applicable distance or the starting distance is applied regarding the road sign location.	0..1	ApplicableDistanceQualifierEnum
	distanceUnit	Distance unit	The unit associated with the distance value.	0..1	LengthUnitEnum
	startingPointDistance	Starting point distance	The distance at which the prescription or the danger warning starts.	0..1	Float
SignPictogram	pictogramFlashing	Pictogram flashing	Indication of whether the pictogram is flashing or not.	1..1	Boolean
	pictogramInInverseColour	Pictogram in inverse colour	The pictogram is displayed in inverse colour (i.e. the colours are the inverse of normal).	0..1	Boolean
	pictogramReference	Pictogram reference	Provides a reference to the associated pictogram in the referenced catalogue.	1..1	Reference
	presenceOfRedTriangle	Presence of red triangle	Indication of the presence of a red triangle around the pictogram, often used to indicate imminence, typically within 2km, of signed danger.	1..1	Boolean
SpeedAttribute	speedAttribute	Speed attribute	The speed value associated with the considered pictogram.	1..1	Float
	speedAttributeUnit	Speed attribute unit	The unit associated with the speed value.	0..1	SpeedAttributeUnitEnum
VehicleDimension	lengthAttribute	Length attribute	Value of length that is displayed as part of the pictogram (e.g. for a vehicle length restriction).	0..1	Float
	lengthUnit	Length unit	The unit associated with the length value displayed on the pictogram.	0..1	LengthUnitEnum
	weightAttribute	Weight attribute	Value of weight that is displayed as part of the pictogram (e.g. for a maximum weight restriction).	0..1	Float
	weightUnit	Weight unit	The unit associated with the weight value displayed on the pictogram.	0..1	WeightUnitEnum
SupplementaryPanel	supplementaryPanelTextLine	Supplementary panel text line	The text displayed on the supplementary panel.	0..1	String

Table A.16 *(continued)*

Class name	Attribute name	Designation	Definition	Multiplicity	Type
	supplementaryPanelTextLineLanguage	Supplementary panel text line language	The language associated with the supplementary panel text.	0..1	Language
SupplementaryPictogram	pictogramFlashing	Pictogram flashing	Indication of whether the pictogram is flashing.	0..1	Boolean
	supplementaryPictogramReference	Supplementary pictogram reference	Provides a reference to the associated pictogram in the referenced catalogue.	1..1	Reference
TextLine	textLine	Text line	A free-text string that is displayed on a single line on the text display area.	1..1	String
	textLineFlashing	Text line flashing	Indication of whether the displayed line of text is flashing.	0..1	Boolean
	textLineLanguage	Text line language	The language of the displayed line of text specified by an ISO 639-1, 2-alpha code.	0..1	Language

A.5.2.8 "Validity" package

A.5.2.8.1 "Validity" package classes

Table A.17 — Classes of the "Validity" package

Class name	Designation	Definition	Stereotype	Abstract
OverallPeriod	Overall period	A continuous or discontinuous period of validity defined by overall bounding start and end times and the possible intersection of valid periods (potentially recurring) with the complement of exception periods (also potentially recurring).		no
Validity	Validity	Specification of validity, either explicitly or by validity time period specification which may be discontinuous.		no

A.5.2.8.2 "Validity" package association roles

Table A.18 — Associations of the "Validity" package

Class name	Role name	Designation	Definition	Multiplicity	Target
Validity	validityTimeSpecification	Validity time specification	A specification of periods of validity defined by overall bounding start and end times and the possible intersection of valid periods with exception periods (exception periods overriding valid periods).	1..1	OverallPeriod

A.5.2.8.3 "Validity" package attributes

Table A.19 — Attributes of the "Validity" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
Overall-Period	overallEndTime	Overall end time	End of bounding period of validity defined by date and time.	0..1	DateTime
	overallStartTime	Overall start time	Start of bounding period of validity defined by date and time.	1..1	DateTime
Validity	validityStatus	Validity status	Specification of validity, either explicitly overriding the validity time specification or confirming it.	1..1	ValidityStatusEnum

A.5.2.9 "VehicleCharacteristics" package

A.5.2.9.1 "VehicleCharacteristics" package classes

Table A.20 — Classes of the "VehicleCharacteristics" package

Class name	Designation	Definition	Stereotype	Abstract
GrossWeightCharacteristic	Gross weight characteristic	Gross weight characteristic of a vehicle.		no
HeaviestAxleWeightCharacteristic	Heaviest axle weight characteristic	Weight characteristic of the heaviest axle on the vehicle.		no
HeightCharacteristic	Height characteristic	Height characteristic of a vehicle.		no
LengthCharacteristic	Length characteristic	Length characteristic of a vehicle.		no
NumberOfAxlesCharacteristic	Number of axles characteristic	Number of axles characteristic of a vehicle.		no
VehicleCharacteristics	Vehicle characteristics	The characteristics of a vehicle, e.g. lorry of gross weight greater than 30 tonnes.		no
WidthCharacteristic	Width characteristic	Width characteristic of a vehicle.		no

A.5.2.9.2 "VehicleCharacteristics" package association roles

There are no defined association roles in the "VehicleCharacteristics" package.

A.5.2.9.3 "VehicleCharacteristics" package attributes

Table A.21 — Attributes of the "VehicleCharacteristics" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
GrossWeightCharacteristic	comparisonOperator	Comparison operator	The operator to be used in the vehicle characteristic comparison operation.	1..1	ComparisonOperatorEnum
	grossVehicleWeight	Gross vehicle weight	The gross weight of the vehicle and its load, including any trailers.	1..1	Float
	grossVehicleWeightUnit	Gross vehicle weight unit	Units used with different weight attributes.	0..1	WeightUnitEnum

Table A.21 *(continued)*

Class name	Attribute name	Designation	Definition	Multiplicity	Type
HeaviestAxleWeightCharacteristic	comparisonOperator	Comparison operator	The operator to be used in the vehicle characteristic comparison operation.	1..1	ComparisonOperatorEnum
	heaviestAxleWeight	Heaviest axle weight	The weight of the heaviest axle on the vehicle.	1..1	Float
	heaviestAxleWeightUnit	Heaviest axle weight unit	Units used with different weight attributes.	0..1	WeightUnitEnum
HeightCharacteristic	comparisonOperator	Comparison operator	The operator to be used in the vehicle characteristic comparison operation.	1..1	ComparisonOperatorEnum
	vehicleHeight	Vehicle height	The height of the highest part, excluding antennae, of an individual vehicle above the road surface, in metres.	1..1	Float
	vehicleHeightUnit	Vehicle height unit	Units used with different length attributes (length, width, and height).	0..1	LengthUnitEnum
LengthCharacteristic	comparisonOperator	Comparison operator	The operator to be used in the vehicle characteristic comparison operation.	1..1	ComparisonOperatorEnum
	vehicleLength	Vehicle length	The overall distance between the front and back of an individual vehicle, including the length of any trailers, couplings, etc.	1..1	MetresAsFloat
	vehicleLengthUnit	Vehicle length unit	Units used with different length attributes (length, width, and height).	0..1	LengthUnitEnum
NumberOfAxlesCharacteristic	comparisonOperator	Comparison operator	The operator to be used in the vehicle characteristic comparison operation.	1..1	ComparisonOperatorEnum
	numberOfAxles	Number of axles	The total number of axles of an individual vehicle.	1..1	NonNegativeInteger
VehicleCharacteristics	driverStatus	Driver status	The status of driver the regulation is applicable for (e.g. learner drivers).	0..1	DriverStatusEnum
	fuelType	Fuel type	The type of fuel used by the vehicle.	0..1	FuelTypeEnum
	loadType	Load type	The type of load carried by the vehicle, especially in respect of hazardous loads.	0..1	LoadTypeEnum
	vehicleEquipment	Vehicle equipment	The type of equipment in use or on board the vehicle.	0..1	VehicleEquipmentEnum
	vehicleType	Vehicle type	Vehicle type.	0..*	VehicleTypeEnum
	vehicleUsage	Vehicle usage	The type of usage of the vehicle (i.e. for what purpose is the vehicle being used).	0..1	VehicleUsageEnum
WidthCharacteristic	comparisonOperator	Comparison operator	The operator to be used in the vehicle characteristic comparison operation.	1..1	ComparisonOperatorEnum
	vehicleWidth	Vehicle width	The maximum width of an individual vehicle, in metres.	1..1	MetresAsFloat
	vehicleWidthUnit	Vehicle width unit	Units used with different length attributes (length, width, and height).	0..1	LengthUnitEnum

A.5.2.10 "Vms" package

A.5.2.10.1 "Vms" package classes

Table A.22 — Classes of the "Vms" package

Class name	Designation	Definition	Stereotype	Abstract
PictogramDisplayAreaSettings	Pictogram display area settings	Settings specific to a distinct pictogram display area on the VMS (where pictogramIndex indicates which pictogram area it relates to if there is more than one pictogram display area on the VMS).		no
TextDisplayAreaSettings	Text display area settings	Settings specific to a distinct text display area on the VMS.		no
Vms	VMS	Provides the current status and settings of the VMS and the currently displayed information. Where a VMS is displaying a sequence or alternating set of messages, these are ordered according to the messageIndex qualifier.		no

A.5.2.10.2 "Vms" package association roles

There are no defined association roles in the "Vms" package.

A.5.2.10.3 "Vms" package attributes

Table A.23 — Attributes of the "Vms" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
PictogramDisplayAreaSettings	pictogramLanternsOn	Pictogram lanterns on	Indicates if the lanterns are turned on or off for the pictogram display area.	0..1	Boolean
TextDisplayAreaSettings	textLanternsOn	Text lanterns on	Indicates if the lanterns are turned on or off for the text display area.	0..1	Boolean
Vms	vmsMessageSequencingInterval	VMS message sequencing interval	The time duration that each message is displayed for before the VMS displays the next message in the sequence.	0..1	Seconds
	vmsReferenceLayoutIdentifier	VMS reference layout identifier	The identifier to a reference layout in the catalogue used for rendering the corresponding VMS content.	1..1	Reference

A.5.2.11 "VmsContent" package

A.5.2.11.1 "VmsContent" package classes

Table A.24 — Classes of the "VmsContent" package

Class name	Designation	Definition	Stereotype	Abstract
VmsContent	VMS content	A content containing the current status and settings of one VMS.		no

A.5.2.11.2 "VmsContent" package association roles

There are no defined association roles in the "VmsContent" package.

A.5.2.11.3 "VmsContent" package attributes

There are no defined attributes in the "VmsContent" package.

A.5.2.12 "VmsMessage" package

A.5.2.12.1 "VmsMessage" package classes

Table A.25 — Classes of the "VmsMessage" package

Class name	Designation	Definition	Stereotype	Abstract
VmsMessage	VMS message	A message displayed on a VMS which may comprise one or more sequentially displayed text pages and/or pictograms with supplementary details. When in a sequence of displayed messages, sequencing of text pages and pictograms within a message are prohibited.		no
VmsPictogramDisplayArea	VMS pictogram display area	An area on a VMS used for the display of pictograms and associated supplemental information or instructions.		no
VmsText	VMS text	A page of text (comprising one or more ordered lines) that are displayed simultaneously on the VMS. Where more than one page is defined, these are sequentially displayed according to their "pageNumber".		no

A.5.2.12.2 "VmsMessage" package association roles

Table A.26 — Associations of the "VmsMessage" package

Class name	Role name	Designation	Definition	Multiplicity	Target
VmsMessage	textPage	Text page		1..1	VmsText

A.5.2.12.3 "VmsMessage" package attributes

Table A.27 — Attributes of the "VmsMessage" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
VmsMessage	textPictogramSequencingInterval	Text pictogram sequencing interval	The time duration that each text page or pictogram within a message is displayed for before the VMS displays the next text page and/or pictogram in the message.	0..1	Seconds
	timeLastSet	Time last set	The date/time at which the sign was last set.	1..1	DateTime
	vmsMessageInformationType	VMS message information type	Type of information being displayed.	0..*	VmsMessageInformationTypeEnum
VmsPictogramDisplayArea	synchronizedSequencingWithTextPages	Synchronized sequencing with text pages	Indicates whether the sequence of pictograms is sequenced synchronously with the text pages. If there is a mismatch in the number of sequenced text pages and sequenced pictograms, the sequences are assumed to resynchronise at the start of each sequence.	0..1	Boolean
VmsText	verticalTextLayout	Vertical text layout	Indicates whether the text displayed on the VMS is currently displayed vertically for languages where it is meaningful. By default it is set to False.	1..1	Boolean

A.5.2.13 "VmsRelated" package

A.5.2.13.1 "VmsRelated" package classes

Table A.28 — Classes of the "VmsRelated" package

Class name	Designation	Definition	Stereotype	Abstract
VmsPictogramDisplayCharacteristics	VMS pictogram display characteristics	Characteristics specific to the pictogram display area(s) on the VMS where pictogramDisplayAreaIndex indicates which pictogram area it relates to.		no
VmsSupplementaryPanelCharacteristics	VMS supplementary panel characteristics	Characteristics of a panel which may display details (sometimes regulatory in nature) that are supplemental to the main pictogram, comprising an additional line of text and/or a pictogram.		no
VmsTextDisplayCharacteristics	VMS text display characteristics	Characteristics specific to the textual display area on the VMS.		no

A.5.2.13.2 "VmsRelated" package association roles

There are no defined association roles in the "VmsRelated" package.

A.5.2.13.3 "VmsRelated" package attributes

Table A.29 — Attributes of the "VmsRelated" package

Class name	Attribute name	Designation	Definition	Multiplicity	Type
VmsPictogramDisplayCharacteristics	pictogramPixelsAcross	Pictogram pixels across	Number of pixels horizontally across the pictogram display area of the VMS.	0..1	NonNegativeInteger
	pictogramPixelsDown	Pictogram pixels down	Number of pixels vertically down the pictogram display area of the VMS.	0..1	NonNegativeInteger
	pictogramPositionAbsolute	Pictogram position absolute	The position of the area in which the pictogram is displayed, i.e. at the left, right, top, or bottom of the VMS display.	0..1	PositionAbsoluteEnum
	pictogramPositionRelativeToText	Pictogram position relative to text	The position of the area in which the pictogram is displayed relative to the textual area of the VMS (e.g. to the left, to the right….).	0..1	PositionRelativeEnum
	pictogramPositionX	Pictogram position x	The X-coordinate (horizontal) position of the area in which the pictogram is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific pictogram display area.	0..1	NonNegativeInteger
	pictogramPositionY	Pictogram position y	The Y-coordinate (vertical) position of the area in which the pictogram is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific pictogram display area.	0..1	NonNegativeInteger
	pictogramSequencingCapable	Pictogram sequencing capable	Indicates whether the pictogram display area on the VMS is capable of sequencing through multiple pictograms. True = capable.	0..1	Boolean
VmsSupplementaryPanelCharacteristics	supplementaryPanelDisplayWidth	Supplementary panel display width	The horizontal width measured in metres of the supplementary panel display area.	0..1	NonNegativeInteger
	supplementaryPanelPixelsAcross	Supplementary panel pixels across	Number of pixels horizontally across the supplementary panel display area.	0..1	NonNegativeInteger
	supplementaryPanelPixelsDown	Supplementary panel pixels down	Number of pixels vertically down the supplementary panel display area.	0..1	NonNegativeInteger
	supplementaryPanelPositionX	Supplementary panel position x	The X-coordinate (horizontal) position of the supplementary panel measured from the bottom left of the sign's overall display area to the bottom left of the supplementary panel.	0..1	NonNegativeInteger
	supplementaryPanelPositionY	Supplementary panel position y	The Y-coordinate (vertical) position of the supplementary panel measured from the bottom left of the sign's overall display area to the bottom left of the supplementary panel.	0..1	NonNegativeInteger

Table A.29 *(continued)*

Class name	Attribute name	Designation	Definition	Multiplicity	Type
VmsTextDisplayCharacteristics	maxFontHeight	Max font height	Maximum font height in pixels.	0..1	NonNegativeInteger
	maxFontSpacing	Max font spacing	Maximum font spacing in pixels.	0..1	NonNegativeInteger
	maxFontWidth	Max font width	Maximum font width in pixels.	0..1	NonNegativeInteger
	maxNumberOfCharacters	Max number of characters	Maximum number of displayable characters on a single line in the textual display area of the VMS.	0..1	NonNegativeInteger
	maxNumberOfRows	Max number of rows	Maximum number of rows of displayable characters in the textual display area of the VMS.	0..1	NonNegativeInteger
	maxNumberOfSequentialPages	Max number of sequential pages	Maximum number of text pages which the VMS is capable of scrolling through sequentially, (2 to n).	0..1	NonNegativeInteger
	minFontHeight	Min font height	Minimum font height in pixels.	0..1	NonNegativeInteger
	minFontSpacing	Min font spacing	Minimum font spacing in pixels.	0..1	NonNegativeInteger
	minFontWidth	Min font width	Minimum font width in pixels.	0..1	NonNegativeInteger
	textPageSequencingCapable	Text page sequencing capable	Indicates whether the text display on the VMS is capable of sequencing through multiple pages of text. True = capable.	0..1	Boolean
	textPixelsAcross	Text pixels across	Number of pixels horizontally across the textual display area of the VMS.	0..1	NonNegativeInteger
	textPixelsDown	Text pixels down	Number of pixels vertically down the textual display area of the VMS.	0..1	NonNegativeInteger
	textPositionAbsolute	Text position absolute	The position of the area in which the text is displayed, e.g. at the left, right, top, or bottom of the VMS display.	0..1	PositionAbsoluteEnum
	textPositionX	Text position x	The X-coordinate (horizontal) position of the area in which the text is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific text display area.	0..1	NonNegativeInteger
	textPositionY	Text position y	The Y-coordinate (vertical) position of the area in which the text is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific text display area.	0..1	NonNegativeInteger
	verticalTextFeature	Vertical text feature	Indicates whether the VMS text display area is capable of displaying texts vertically. True = capable.	0..1	Boolean

A.5.3 Definition of the IVS data types

Table A.30 defines the different data types as they are figured in the packages "Generic" and "Specific".

Table A.30 — The "Generic" and "Specific" data types packages

Package name	Class name	Designation	Definition
Generic	Boolean	— (Datatype)	Boolean has the value space required to support the mathematical concept of binary-valued logic: {true, false}.
	Country	— (Datatype)	A country data type that identifies a specified country, based on ISO 3166-1.
	Date	— (Datatype)	A combination of year, month, and day integer-valued properties plus an optional time zone property. It represents an interval of exactly one day, beginning on the first moment of the day in the time zone, i.e. '00:00:00' up to but not including '24:00:00'.
	DateTime	— (Datatype)	A combination of integer-valued year, month, day, hour, minute properties, a decimal-valued second property, and a time zone property from which it is possible to determine the local time, the equivalent UTC time, and the time zone offset from UTC.
	Float	— (Datatype)	A floating point number whose value space consists of the values m × 2^e, where m is an integer whose absolute value is less than 2^24, and e is an integer between –149 and 104, inclusive.
	Integer	— (Datatype)	An integer number whose value space is the set {-214 748 364 8, –214 748 364 7, –214 748 364 6, …, –2, –1, 0, 1, 2, …, 214 748 364 5, 214 748 364 6, 214 748 364 7}.
	JpegPicture	— (Datatype)	A container able to convey any JPEG-formatted picture file.
	Language	— (Datatype)	A language data type that identifies a specified language, based on ISO 639-1.
	MultilingualString	— (Datatype)	A multilingual string, whereby the same text may be expressed in more than one language.
	NonNegativeInteger	— (Datatype)	An integer number whose value space is the set {0, 1, 2, …, 214 748 364 5, 214 748 364 6, 214 748 364 7}.
	Reference	— (Datatype)	A reference to an identifiable managed object where the identifier is unique. It comprises an identifier (e.g. GUID) and a string identifying the class of the referenced object.
	String	— (Datatype)	A character string whose value space is the set of finite-length sequences of characters. Every character has a corresponding Universal Character Set code point (as defined in ISO/IEC 10646), which is an integer.
	Time	— (Datatype)	An instant of time that recurs every day. The value space of time is the space of time of day values as defined in ISO 8601:2004, 5.3. Specifically, it is a set of zero-duration daily time instances.
	VersionedReference	— (Datatype)	A reference to an identifiable version managed object where the combination of the identifier and version is unique. It comprises an identifier (e.g. GUID), a version (NonNegativeInteger), and a string identifying the class of the referenced object.
Specific	KiloHertz	— (Datatype)	A measure of frequency defined in kilohertz.
	Percentage	— (Datatype)	A measure of percentage.
	Seconds	— (Datatype)	Seconds.

A.5.4 Definition of the IVS enumerations

This subclause contains the definitions of all enumerations which are used in the IVS publications.

A.5.4.1 The <<enumeration>> "ApplicableDistanceQualifierEnum" is the qualifier applied to a distance regarding the road sign position.

Table A.31 — Values contained in the enumeration "ApplicableDistanceQualifierEnum"

Enumerated value name	Integer value	Designation	Definition
from	0	From	From this point.
until	1	Until	Until this point.
onEitherSide	2	On either side	On either side of this point.

A.5.4.2 The <<enumeration>> "ComparisonOperatorEnum" is the logical comparison operations.

Table A.32 — Values contained in the enumeration "ComparisonOperatorEnum"

Enumerated value name	Integer value	Designation	Definition
equalTo	0	Equal to	Logical comparison operator of "equal to".
greaterThan	1	Greater than	Logical comparison operator of "greater than".
greaterThanOrEqual-To	2	Greater than or equal to	Logical comparison operator of "greater than or equal to".
lessThan	3	Less than	Logical comparison operator of "less than".
lessThanOrEqualTo	4	Less than or equal to	Logical comparison operator of "less than or equal to".

A.5.4.3 The <<enumeration>> "DriverStatusEnum" is the status of a driver regarding regulation.

Table A.33 — Values contained in the enumeration "DriverStatusEnum"

Enumerated value name	Integer value	Designation	Definition
allDrivers	0	All drivers	Applicable to all drivers.
learnerDrivers	1	Learner drivers	Applicable to learner drivers.

A.5.4.4 The <<enumeration>> "FuelTypeEnum" is the type of fuel used by a vehicle.

Table A.34 — Values contained in the enumeration "FuelTypeEnum"

Enumerated value name	Integer value	Designation	Definition
battery	0	Battery	Battery.
biodiesel	1	Biodiesel	Biodiesel.
diesel	2	Diesel	Diesel.
dieselBatteryHy-brid	3	Diesel battery hybrid	Diesel and battery hybrid.
ethanol	4	Ethanol	Ethanol.
hydrogen	5	Hydrogen	Hydrogen.
liquidGas	6	Liquid gas	Liquid gas of any type including LPG.
lpg	7	LPG	Liquid petroleum gas.
methane	8	Methane	Methane gas.
petrol	9	Petrol	Petrol.
petrolBatteryHy-brid	10	Petrol battery hybrid	Petrol and battery hybrid.

A.5.4.5 The <<enumeration>> "IvsMessageTypeEnum" is the type of the IVS message delivered by a content provider.

Table A.35 — Values contained in the enumeration "ApplicableDistanceQualifierEnum"

Enumerated value name	Integer value	Designation	Definition
immediateDanger-WarningMessages	0	Immediate danger warning messages	Immediate danger warning messages: Alert on a danger involving drivers' or other users' safety, warning, usually displayed within a prescribed distance
regulatoryMes-sages	1	Regulatory mes-sages	Regulatory messages: Prohibition, restriction, obligation or special regulation (that may depend on the vehicle type), compulsory routes, and rerouting.
trafficRelatedMes-sages	2	Traffic related messages	Traffic-related information messages: Events (that are not im-mediate dangers), driving conditions, forecasts (congestion, weather, events), travel time, advisory alternate route, etc.
pollutionMessages	3	Pollution mes-sages	Pollution messages: There are two thresholds: Information messages and warning messages. Both exclude speed limits and other driving prohibitions or obligations which are part of primary service
nonTrafficRelated-Messages	4	Non traffic relat-ed messages	Not traffic-related information messages including but not limited to abduction alert, also sometimes called "amber alert".

A.5.4.6 The <<enumeration>> "LengthUnitEnum" are the units used with different length attributes (distance, length, width, and height).

Table A.36 — Values contained in the enumeration "LengthUnitEnum"

Enumerated value name	Integer value	Designation	Definition
Metres	0	Metres	Metres as length unit.
kilometres	1	Kilometres	Kilometres as length unit.
feetInches	2	Feet and inches	Feet and inches as length unit.
Miles	3	Miles	Miles as length unit.

A.5.4.7 The <<enumeration>> “LoadTypeEnum” are types of load carried by a vehicle.

Table A.37 — Values contained in the enumeration “LoadTypeEnum”

Enumerated value name	Integer value	Designation	Definition
abnormalLoad	0	Abnormal load	A load that exceeds normal vehicle dimensions in terms of height, length, width, gross vehicle weight or axle weight, or any combination of these. Generally termed an “abnormal load”.
ammunition	1	Ammunition	Ammunition.
chemicals	2	Chemicals	Chemicals of unspecified type.
combustibleMaterials	3	Combustible materials	Combustible materials of unspecified type.
corrosiveMaterials	4	Corrosive materials	Corrosive materials of unspecified type.
debris	5	Debris	Debris of unspecified type.
empty	6	Empty	No load.
explosiveMaterials	7	Explosive materials	Explosive materials of unspecified type.
extraHighLoad	8	Extra high load	A load of exceptional height.
extraLongLoad	9	Extra long load	A load of exceptional length.
extraWideLoad	10	Extra wide load	A load of exceptional width.
fuel	11	Fuel	Fuel of unspecified type.
glass	12	Glass	Glass.
goods	13	Goods	Any goods of a commercial nature.
hazardousMaterials	14	Hazardous materials	Materials classed as being of a hazardous nature.
liquid	15	Liquid	Liquid of an unspecified nature.
livestock	16	Livestock	Livestock.
materials	17	Materials	General materials of unspecified type.
materialsDangerousForPeople	18	Materials dangerous for people	Materials classed as being of a danger to people or animals.
materialsDangerousForTheEnvironment	19	Materials dangerous for the environment	Materials classed as being potentially dangerous to the environment.
materialsDangerousForWater	20	Materials dangerous for water	Materials classed as being dangerous when exposed to water (e.g. materials which may react exothermically with water).
oil	21	Oil	Oil.
ordinary	22	Ordinary	Materials that present limited environmental or health risk. Non-combustible, non-toxic, non-corrosive.
other	23	Other	Other than as defined in this enumeration.
perishableProducts	24	Perishable products	Products or produce that will significantly degrade in quality or freshness over a short period of time.
petrol	25	Petrol	Petrol or petroleum.
pharmaceuticalMaterials	26	Pharmaceutical materials	Pharmaceutical materials.

Table A.37 *(continued)*

Enumerated value name	Integer value	Designation	Definition
radioactiveMaterials	27	Radioactive materials	Materials that emit significant quantities of electro-magnetic radiation that may present a risk to people, animals, or the environment.
refuse	28	Refuse	Refuse.
toxicMaterials	29	Toxic materials	Materials of a toxic nature which may damage the environment or endanger public health.
vehicles	30	Vehicles	Vehicles of any type which are being transported.

A.5.4.8 The <<enumeration>> "PositionAbsoluteEnum" are the absolute positions of an item within an allotted space.

Table A.38 — Values contained in the enumeration "PositionAbsoluteEnum"

Enumerated value name	Integer value	Designation	Definition
atBottom	0	At bottom	At the bottom of the allotted space.
atTop	1	At top	At the top of the allotted space.
onLeft	2	On left	On the left of the allotted space.
onRight	3	On right	On the right of the allotted space.

A.5.4.9 The <<enumeration>> "PositionRelativeEnum" are the relative positions of an item to another.

Table A.39 — Values contained in the enumeration "PositionRelativeEnum"

Enumerated value name	Integer value	Designation	Definition
above	0	Above	Positioned above relative item
below	1	Below	Positioned below relative item.
toTheLeft	2	To the left	Positioned to the left of relative item.
toTheRight	3	To the right	Positioned to the right of relative item

A.5.4.10 The <<enumeration>> "SpeedAttributeUnitEnum" are the units used for speed attributes.

Table A.40 — Values contained in the enumeration "SpeedAttributeUnitEnum"

Enumerated value name	Integer value	Designation	Definition
kilometresPerHour	0	Kilometres per hour	Kilometres per hour as speed unit.
milesPerHour	1	Miles per hour	Miles per hour as speed unit.

A.5.4.11 The <<enumeration>> "ValidityStatusEnum" are the values of validity status that can be assigned to a described event, action, or item.

Table A.41 — Values contained in the enumeration "ValidityStatusEnum"

Enumerated value name	Integer value	Designation	Definition
active	0	Active	The described event, action, or item is currently active regardless of the definition of the validity time specification.
definedByValidityTimeSpec	1	Defined by validity time specification	The validity status of the described event, action, or item is in accordance with the definition of the validity time specification.
suspended	2	Suspended	The described event, action, or item is currently suspended, that is inactive, regardless of the definition of the validity time specification.

A.5.4.12 The <<enumeration>> "VehicleEquipmentEnum" are the types of vehicle equipment in use or on board.

Table A.42 — Values contained in the enumeration "VehicleEquipmentEnum"

Enumerated value name	Integer value	Designation	Definition
notUsingSnowChains	0	Not using snow chains	Vehicle not using snow chains.
notUsingSnowChainsOrTyres	1	Not using snow chains or tyres	Vehicle not using either snow tyres or snow chains.
snowChainsInUse	2	Snow chains in use	Vehicle using snow chains.
snowChainsOrTyresInUse	3	Snow chains or tyres in use	Vehicle using snow tyres or snow chains.
snowTyresInUse	4	Snow tyres in use	Vehicle using snow tyres.
withoutSnowTyresOrChainsOnBoard	5	Without snow tyres or chains on board	Vehicle which is not carrying on board snow tyres or chains.

A.5.4.13 The <<enumeration>> "VehicleTypeEnum" are types of vehicle.

Table A.43 — Values contained in the enumeration "VehicleTypeEnum"

Enumerated value name	Integer value	Designation	Definition
agriculturalVehicle	0	Agricultural vehicle	Vehicle normally used for agricultural purposes, e.g. tractor, combined harvester, etc.
anyVehicle	1	Any vehicle	Vehicle of any type.
articulatedVehicle	2	Articulated vehicle	Articulated vehicle.
bicycle	3	Bicycle	Bicycle.
bus	4	Bus	Bus.
car	5	Car	Car.
caravan	6	Caravan	Caravan.
carOrLightVehicle	7	Car or light vehicle	Car or light vehicle.
carWithCaravan	8	Car with caravan	Car towing a caravan.
carWithTrailer	9	Car with trailer	Car towing a trailer.
constructionOrMaintenanceVehicle	10	Construction or maintenance vehicle	Vehicle normally used for construction or maintenance purposes, e.g. digger, excavator, bulldozer, lorry mounted crane, etc.
fourWheelDrive	11	Four wheel drive	Four wheel drive vehicle.

Table A.43 *(continued)*

Enumerated value name	Integer value	Designation	Definition
highSidedVehicle	12	High sided vehicle	High sided vehicle.
lorry	13	Lorry	Lorry of any type.
moped	14	Moped	Moped (a two wheeled motor vehicle characterized by a small engine typically less than 50cc and by normally having pedals).
motorcycle	15	Motorcycle	Motorcycle.
motorcycleWithSideCar	16	Motorcycle with side car	Three wheeled vehicle comprising a motorcycle with an attached side car.
motorscooter	17	Motorscooter	Motorscooter (a two wheeled motor vehicle characterized by a step-through frame and small diameter wheels).
other	18	Other	Other than as defined in this enumeration.
tanker	19	Tanker	Vehicle with large tank for carrying bulk liquids.
threeWheeledVehicle	20	Three wheeled vehicle	Three wheeled vehicle of unspecified type.
trailer	21	Trailer	Trailer.
tram	22	Tram	Tram.
twoWheeledVehicle	23	Two wheeled vehicle	Two wheeled vehicle of unspecified type.
van	24	Van	Van.
vehicleWithCaravan	25	Vehicle with caravan	Vehicle (of unspecified type) towing a caravan.
vehicleWithCatalyticConverter	26	Vehicle with catalytic converter	Vehicle with catalytic converter.
vehicleWithoutCatalyticConverter	27	Vehicle without catalytic converter	Vehicle without catalytic converter.
vehicleWithTrailer	28	Vehicle with trailer	Vehicle (of unspecified type) towing a trailer.
withEvenNumberedRegistrationPlates	29	With even numbered registration plates	Vehicle with even numbered registration plate.
withOddNumberedRegistrationPlates	30	With odd numbered registration plates	Vehicle with odd numbered registration plate.

A.5.4.14 The <<enumeration>> “VehicleUsageEnum” are types of usage of a vehicle.

Table A.44 — Values contained in the enumeration “VehicleUsageEnum”

Enumerated value name	Integer value	Designation	Definition
agricultural	0	Agricultural	Vehicle used for agricultural purposes.
commercial	1	Commercial	Vehicle which is limited to non-private usage or public transport usage.
emergencyServices	2	Emergency services	Vehicle used by the emergency services.
military	3	Military	Vehicle used by the military.
nonCommercial	4	Non commercial	Vehicle used for non-commercial or private purposes.
patrol	5	Patrol	Vehicle used as part of a patrol service, e.g. road operator or automobile association patrol vehicle.
recoveryServices	6	Recovery services	Vehicle used to provide a recovery service.
roadMaintenanceOrConstruction	7	Road maintenance or construction	Vehicle used for road maintenance or construction work purposes.
roadOperator	8	Road operator	Vehicle used by the road operator.
taxi	9	Taxi	Vehicle used to provide an authorized taxi service.

A.5.4.15 The <<enumeration>> “VmsMessageInformationTypeEnum” are types of information displayable on a VMS.

Table A.45 — Values contained in the enumeration “VmsMessageInformationTypeEnum”

Enumerated value name	Integer value	Designation	Definition
campaignMessage	0	Campaign message	Campaign type information which is non time specific that may request certain actions (e.g. “do not drink and drive”) or which is intended to influence drivers’ behaviour.
dateTime	1	Date time	Current date and/or time information.
futureInformation	2	Future information	Information which may inform road users about future situations which potentially may cause congestion or influence future travel plans (e.g. future roadworks, closures, sporting events, public concerts, suspension of train, or ferry services).
instructionOrMessage	3	Instruction or message	Instructions or messages to road users which are relevant at the current time, (e.g. “do not throw out any burning objects” or an Amber alert message).
situationWarning	4	Situation warning	Information warning of a current situation likely to affect traffic on the road ahead.
temperature	5	Temperature	Temperature information.
trafficManagement	6	Traffic management	Information comprising traffic management instructions.
travelTime	7	Travel time	Travel time information.

A.5.4.16 The <<enumeration>> "WeightUnitEnum" are the units used with different weight attributes.

Table A.46 — Values contained in the enumeration "WeightUnitEnum"

Enumerated value name	Integer value	Designation	Definition
tonnes	0	Tonnes	Unit of weight equal to 1 000 kg.
shortTons	1	Short tons	Unit of weight equal to 2 000 pounds or 907,184 kg.
quintals	2	Quintals	Unit of weight equal to 100 kg

A.6 Tabular presentation of the IVS messages

A.6.1 Definition of the content message

The IVS message structure and content that is derived from the above requirements and data model is provided by the Table A.47 ("SignContent"). It specifies the data elements which are required (M: Mandatory), conditional (C: Conditional), or optional (O: Optional) to support the IVS application. The requirements justifying the availability of the data elements in IVI are identified in the Table.

Table A.47 — IVS message structure and content

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
C1	COMMON HEADER	Includes the message type (IVS) and the protocol version: 1 for the current version.		M
C2	MESSAGE TYPE	Choice between the different message types (here: "IVS content message").		M
C3	ORIGINATOR ID	Identifier of the ITS-S which is at the origin of the message.	SR030	M or O according to flow type
C4	IVS CONTENT GENERATION TIME	Timestamp of the message. Milliseconds elapsed since midnight January 1st 1970 UTC.	MR020	M
C5	AUTHORIZED CONTENT PROVIDER ID	Identifier of the authorized content provider. This may indicate the responsibility level.	CR020	M
C6	AUTHORIZED SERVICE PROVIDER ID	Optionally provides the ID of the service provider.	SR010	O
C7	LANGUAGE BY DEFAULT	Provides the language used by default in the different message text of the batch (based on ISO 639-1)	CR050	M
C8	IVS CATALOGUE REFERENCE	Provides the reference to the national/regional catalogue to be used when decoding the IVS message		M

[a] The blocks R1 to R12, V1 to V18, or F1 to F4 are repeated according to number of data elements ("SignContent") comprised in the publication (block 9).

[b] For VMS and full-matrix signs using several pages, the content between blocks V3 to V18 (respectively F3 to F4) are repeated according to the number of pages (block V2 or F2).

[c] For VMS, for each global page (text and pictograms), the blocks V8 to V18 are repeated according to the number of pictograms of the page (block V7).

Table A.47 *(continued)*

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
C9	NUMBER OF SIGNAGE CONTENTS	Indicates the number of sign contents contained in the message. By default it is "1".		C
C10	IVS MESSAGE ELEMENT IDENTIFIER	Provides a unique identifier to the corresponding IVS message in order to allow its future management	CR030, MR020	C (in case of new messages)
C11[a]	IVSM REFERENCE	Provides the reference of the already provided IVS message in order to update, end or cancel it.	CR030, MR040	C (in case of update)
C12[b]	SIGNAGE CATEGORY	Provides the road sign category (Fix, VMS or Full-matrix) as well as a standard style code in use in the travelled country. If it is a full-matrix, the message shall include an adapted full-matrix container.		M
C13	SIGNAGE PRIORITY LEVEL	Provides the driver presentation priority level (1: Regulatory, 2: Immediate danger, 3: Traffic related, 4: Pollution, 5: Not traffic-related) of the signage in case of concurrent signalling.	CR080, MR260	M
C14	IVS PRIORITY OVERRIDE	Overrides for this single IVS message content the priority value defined by default according to the message type by allocating the highest priority.	PR180	O
C15	VEHICLE TYPE APPLICATILITY	Identifies the vehicle types which are targeted by the message sign. This includes the vehicle type and characteristics (mass, high, wide, energy storage type).	CR060	C
C16	VEHICLE CONTENT APPLICABILITY	Specifies the goods being transported by the vehicle especially in case of dangerous goods.	CR060	C
C17	VEHICLE FUEL TYPE APPLICABILITY	Specifies the energy used by the vehicle targeted by the message sign.	CR060	C
C18	VEHICLE EQUIPMENT TYPE APPLICABILITY	Specifies the equipment type used by the vehicle targeted by the message content.	CR060	C
C19	DRIVER STATUS	Specifies the driver status targeted by the message content.	CR060	C
C20	VALIDITY STATUS	Provides the validity status of the message content: 0 in case of permanent message and 1 when the validity period is defined by a start time and an end time	CR090	M
C21	OVERALL START VALIDITY	Start of the validity period (if VALIDITY STATUS = 1).	CR090	C

[a] The blocks R1 to R12, V1 to V18, or F1 to F4 are repeated according to number of data elements ("SignContent") comprised in the publication (block 9).

[b] For VMS and full-matrix signs using several pages, the content between blocks V3 to V18 (respectively F3 to F4) are repeated according to the number of pages (block V2 or F2).

[c] For VMS, for each global page (text and pictograms), the blocks V8 to V18 are repeated according to the number of pictograms of the page (block V7).

Table A.47 *(continued)*

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
C22	OVERALL END VALIDITY	End of the validity period (if known) (if VALIDITY STATUS = 1)	CR090	C
C23	RELEVANCE ZONE DEFINITION	Zone in which the road sign is applicable. It can be a point, a road segment, a road segment set, or an area.	CR070	M
C24	DRIVER AWARENESS ZONE DEFINITION	Delimitation of the driver awareness zone in which the signage has to be provided. It can be a road segment, a road segment set, or an area (provided if different of a point).	CR070	C
C25	TRAFFIC DIRECTION	Indicates the traffic direction to be associated to the awareness and relevance zones.	CR080	M
C26	LANE APPLICABILITY	Indicates one specific lane in the awareness and relevance zone. By default applicable to all lanes.	CR080	O
The following blocks are used for fixed road sign content according to block C11:				
R1	PICTOGRAM HIGHLIGHTING	Boolean string specifying how the pictogram is highlighted (flashing)	PR020	O
R2	PICTOGRAM SERVICE CATEGORY.	Road sign pictogram service code in the catalogue (defined according to ISO/TS 14823).	CR010	M
R3	PICTOGRAM CATEGORY.	Road sign pictogram code in the catalogue (defined according to ISO/TS 14823).	CR010	M
R4	PICTOGRAM VALUE	In case one value has to be associated to pictograms.	CR010	C
R5	PICTOGRAM VALUE UNIT	Units to be associated to values. By default, it will be the corresponding unit expressed in ISO metric system.	CR110	O
R6	SUPPLEMENTARY PANEL TEXT	The supplementary panel text to be added to the road sign.		O
R7	SUPPLEMENTARY PICTOGRAM TEXT LANGUAGE	In case of text on a panel text defined following ISO 639-1 (by default: language by default provided for the IVS message).	CR100	O
R8	SUPPLEMENTARY PANEL TEXT HIGHLIGHTNING	Boolean specifying if the corresponding text is highlighted (flashing).	PR020	O
R10	SUPPLEMENTARY PICTOGRAM SERVICE CATEGORY	Provides the pictogram service code in the catalogue (defined according to ISO/TS 14823).	CR010	O
R11	SUPPLEMENTARY PICTOGRAM CATEGORY	Provides the pictogram code in the catalogue (defined according to ISO/TS 14823).	CR010	O

[a] The blocks R1 to R12, V1 to V18, or F1 to F4 are repeated according to number of data elements (“SignContent”) comprised in the publication (block 9).

[b] For VMS and full-matrix signs using several pages, the content between blocks V3 to V18 (respectively F3 to F4) are repeated according to the number of pages (block V2 or F2).

[c] For VMS, for each global page (text and pictograms), the blocks V8 to V18 are repeated according to the number of pictograms of the page (block V7).

Table A.47 *(continued)*

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
R12	SUPPLEMENTARY PICTOGRAM HIGHLIGHTING	Boolean specifying if the corresponding pictogram is highlighted (flashing).	CR020	O
The following blocks are used for VMS content according to block C11:				
V1	LAYOUT TYPE	Provides the VMS layout according to the national/regional catalogue.	PR130	M
V2	NUMBER OF TEXT PAGES	Provides the number of currently used text pages.		M
V3[b]	TEXT HIGHLIGHTING	Boolean specifying if the corresponding text is highlighted (flashing).	PR020	O
V4	TEXT	Provides the text part of the VMS content.		
V5	TEXT LANGUAGE	Defined following ISO 639-1 (by default: language by default provided for the IVS message).	CR100	O
V6	VERTICAL TEXT LAYOUT	Indicates whether the text displayed on the VMS is currently displayed vertically for languages where it is meaningful.	CR040	O
V7	NUMBER OF PICTOGRAM AREAS	Provides the number of currently used areas (and pictograms).	PR020	M
V8[c]	PICTOGRAM HIGHLIGHTING	Boolean string specifying how the pictogram is rendered and highlighted (flashing, on inverted layout, with a red triangle).	PR020	O
V9	PICTOGRAM SERVICE CATEGORY.	Road sign pictogram service code in the catalogue (defined according to ISO/TS 14823).	CR010	M
V10	PICTOGRAM CATEGORY.	Road sign pictogram code in the catalogue (defined according to ISO/TS 14823).	CR010	M
V11	PICTOGRAM VALUE	In case one value has to be associated to pictograms.	CR010	C
V12	PICTOGRAM VALUE UNIT	Units to be associated to values. By default, it will be the corresponding unit expressed in ISO metric system.	CR110	O
V13	SUPPLEMENTARY PANEL TEXT	The supplementary panel text to be added to the road sign.		O
V14	SUPPLEMENTARY PANEL TEXT LANGUAGE	In case of text on a panel text defined following ISO 639-1 (by default: language by default provided for the IVS message).	CR100	O
V15	SUPPLEMENTARY PANEL TEXT HIGHLIGHTNING	Boolean specifying if the corresponding text is highlighted (flashing).	PR020	O

[a] The blocks R1 to R12, V1 to V18, or F1 to F4 are repeated according to number of data elements (“SignContent”) comprised in the publication (block 9).

[b] For VMS and full-matrix signs using several pages, the content between blocks V3 to V18 (respectively F3 to F4) are repeated according to the number of pages (block V2 or F2).

[c] For VMS, for each global page (text and pictograms), the blocks V8 to V18 are repeated according to the number of pictograms of the page (block V7).

Table A.47 *(continued)*

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
V16	SUPPLEMENTARY PICTOGRAM SERVICE CATEGORY	Provides the pictogram service code in the catalogue (defined according to ISO/TS 14823).	CR010	O
V17	SUPPLEMENTARY PICTOGRAM CATEGORY	Provides the pictogram code in the catalogue (defined according to ISO/TS 14823).	CR010	O
V18	SUPPLEMENTARY PICTOGRAM HIGHLIGHTING	Boolean specifying if the corresponding pictogram is highlighted (flashing).	PR020	O
The following blocks are used for full-matrix VMS content according to block C11:				
F1	LAYOUT TYPE	Provides the full-matrix VMS layout according to the national/regional catalogue	PR130	M
F2	NUMBER OF PAGES	Provides the number of currently used text pages (By default: 1)		O
F3[b]	CONTENT HIGHLIGHTING	Boolean specifying if the corresponding text is highlighted (flashing)	PR020	O
F4	MATRIX	The matrix of pixels according to reference layout indicated in block 25.	CR120	M

[a] The blocks R1 to R12, V1 to V18, or F1 to F4 are repeated according to number of data elements ("SignContent") comprised in the publication (block 9).

[b] For VMS and full-matrix signs using several pages, the content between blocks V3 to V18 (respectively F3 to F4) are repeated according to the number of pages (block V2 or F2).

[c] For VMS, for each global page (text and pictograms), the blocks V8 to V18 are repeated according to the number of pictograms of the page (block V7).

Several points are to be noted.

— The message type (IVS) is to be added in the common header.

— Each data element shall be justified by a specific requirement to be identified in the appropriate column.

— The message sign category identifies a particular association of pictogram(s), text, image (matrix) which can be represented according to a national/regional reference catalogue. This reference catalogue is a guide for the presentation of information to the driver which should be followed. Such catalogue can be downloaded in the vehicle at configuration time and updated later provided that some standard messages be developed for this purpose. Then each country may provide one or several reference catalogues representing how the information is currently provided to driver on physical road signs and VMS.

— A matrix of pixels is characterized by its dimension (length, wide, number of pixels). Several standard matrixes can be identified in the catalogue. A pixel shall be coded on one byte so enabling to provide its colour and brightness level.

— Vehicle applicability identifies the vehicle type(s), the energy storage type, the vehicle role, and the vehicle characteristic (mass, length, wide, high).

A.6.2 Definition of the catalogue message

A second content message is defined for conveying the IVS catalogue publication. It is defined in the following table. The notation conventions are the same as in Table A.47.

Table A.48 — "IVS catalogue" message structure and content

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
1	PROTOCOL VERSION and MESSAGE TYPE	This data element identifies the type of message and the protocol version according to existing standard.		M
2	MESSAGE TYPE	Choice between the different message types (here: "IVS catalogue").		M
3	ORIGINATOR ID	Identifier of the ITS-S which is at the origin of the message.	SR010	M or O according to flow type
4	GENERATION TIME	Timestamp of the message. Milliseconds elapsed since midnight January 1st 1970 UTC.	MR020	M
5	AUTHORIZED CONTENT PROVIDER ID	Identifier of the authorized content provider. May indicate the responsibility level.	CR020	M
6	AUTHORIZED SERVICE PROVIDER ID	Provide the ID of the service provider.	SR010	O
7	LANGUAGE BY DEFAULT	Provides the language used by default in the different message text of the batch (based on ISO 639-1).	CR100	M
8	CATALOGUE REFERENCE	Provides the reference (including its version) to the national/regional catalogue to be used when decoding the IVS message.	PR020	M
9	CATALOGUE COUNTRY	ISO 3166-1 code of the catalogue country.		M
10	CATALOGUE VALIDITY DATE	Date of validity of the provided catalogue.		M
11	NUMBER OF PICTOGRAMS	Provides the number of pictograms defined according to ISO/TS 14826 included in the catalogue.	PR010	M
12[a]	X MAX SIZE of PICTOGRAM	Provides the maximum horizontal size of the corresponding pictogram (in pixels) (by default: 64).	PR010	O
13	Y MAX SIZE of PICTOGRAM	Provides the maximum vertical size of the corresponding pictogram (in pixels) (by default: 64).	PR010	O
14	PICTOGRAM SERVICE CATEGORY.	Pictogram service code in the catalogue (defined according to ISO/TS 14823).	PR010	M
15	PICTOGRAM CATEGORY.	Pictogram code in the catalogue (defined according to ISO/TS 14823).	PR010	M
16	PICTOGRAM DESIGNATION	Provides the description corresponding to the pictogram code and service code.	PR010	O

[a] The blocks 12 to 17 are repeated according to the number of pictogram elements comprised in the publication (block 11).

[b] For VMS, the content between blocks 19 to 48 is repeated according to the number of included VMS reference layout (block 18).

[c] For full-matrix VMS, the blocks 50 to 53 are repeated according to the number of included full-matrix reference layout (block 49).

[d] For VMS, the blocks 37 to 48 are repeated according to the number of included pictogram areas in VMS layout (page) (block 36).

Table A.48 *(continued)*

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
17	PICTOGRAM PICTURE	The corresponding pictogram picture in JPEG format.	PR010	M
18	NUMBER OF REFERENCE VMS LAYOUT	Provides the number of reference VMS layout in the catalogue.	PR010	M
19[b]	VMS REFERENCE LAYOUT IDENTIFIER	Identifier of the VMS reference layout used for rendering VMS content.	PR010	M
20	PRESENCE OF LANTERNS	Indicates whether the VMS is equipped with flashing lanterns.	PR020	O
21	MAX FONT HEIGHT	Maximum font height in pixels.	PR010	O
22	MAX FONT SPACING	Maximum font spacing in pixels.	PR010	O
23	MAX FONT WIDTH	Maximum font width in pixels.	PR010	O
24	MAX NUMBER OF CHARACTERS	Maximum number of displayable characters on a single line in the textual display area of the VMS.	PR010	O
25	MAX NUMBER OF ROWS	Maximum number of rows of displayable characters in the textual display area of the VMS.	PR010	O
26	MAX NUMBER OF SEQUENTIAL PAGES	Maximum number of text pages which the VMS is capable of scrolling through sequentially,	PR010	O
27	MIN FONT HEIGHT	Minimum font height in pixels.	PR010	O
28	MIN FONT SPACING	Minimum font spacing in pixels.	PR010	O
29	MIN FONT WIDTH	Minimum font width in pixels.	PR010	O
30	TEXT PAGE SEQUENCING CAPABLE	Indicates whether the text display on the VMS is capable of sequencing through multiple pages of text. (True = capable.)	PR010	O
31	TEXT PIXELS ACROSS	Number of pixels horizontally across the textual display area of the VMS.	PR010	O
32	TEXT PIXELS DOWN	Number of pixels vertically down the textual display area of the VMS.	PR010	O
33	TEXT POSITION ABSOLUTE	The position of the area in which the text is displayed, e.g. at the left, right, top, or bottom of the VMS display.	PR010	O
34	TEXT POSITION X	The X-coordinate (horizontal) position of the area in which the text is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific text display area.	PR010	O

[a] The blocks 12 to 17 are repeated according to the number of pictogram elements comprised in the publication (block 11).

[b] For VMS, the content between blocks 19 to 48 is repeated according to the number of included VMS reference layout (block 18).

[c] For full-matrix VMS, the blocks 50 to 53 are repeated according to the number of included full-matrix reference layout (block 49).

[d] For VMS, the blocks 37 to 48 are repeated according to the number of included pictogram areas in VMS layout (page) (block 36).

Table A.48 *(continued)*

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
35	TEXT POSITION Y	The Y-coordinate (vertical) position of the area in which the text is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific text display area.	PR010	O
36	VERTICAL TEXT FEATURE	Indicates whether the VMS text display area is capable of displaying texts vertically.	PR010	O
37	NUMBER OF PICTOGRAM AREAS	Provides the number of pictogram areas which can be displayed on the VMS layouts	PR010	M
38[d]	PICTOGRAM PIXELS ACROSS	Number of pixels horizontally across the pictogram display area of the VMS.	PR010	O
39	PICTOGRAM PIXELS DOWN	Number of pixels vertically down the pictogram display area of the VMS.	PR010	O
40	PICTOGRAM POSITION ABSOLUTE	The position of the area in which the pictogram is displayed, i.e. at the left, right, top, or bottom of the VMS display.	PR010	O
41	PICTOGRAM POSITION RELATIVE TO TEXT	The position of the area in which the pictogram is displayed relative to the textual area of the VMS (e.g. to the left, to the right ….).	PR010	O
42	PICTOGRAM POSITION X	The X-coordinate (horizontal) position of the area in which the pictogram is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific pictogram display area.	PR010	O
43	PICTOGRAM POSITION Y	The Y-coordinate (vertical) position of the area in which the pictogram is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific pictogram display area.	PR010	O
44	PICTOGRAM SEQUENCING CAPABLE	Indicates whether the pictogram display area on the VMS is capable of sequencing through multiple pictograms. True = capable.	PR010	O
45	SUPPLEMENTARY PANEL DISPLAY WIDTH	The horizontal width measured in metres of the supplementary panel display area.	PR010	O
46	SUPPLEMENTARY PANEL PIXELS ACROSS	Number of pixels horizontally across the supplementary panel display area.	PR010	O

[a] The blocks 12 to 17 are repeated according to the number of pictogram elements comprised in the publication (block 11).

[b] For VMS, the content between blocks 19 to 48 is repeated according to the number of included VMS reference layout (block 18).

[c] For full-matrix VMS, the blocks 50 to 53 are repeated according to the number of included full-matrix reference layout (block 49).

[d] For VMS, the blocks 37 to 48 are repeated according to the number of included pictogram areas in VMS layout (page) (block 36).

Table A.48 *(continued)*

Block Id	Data Element	Description	Requirement	Optional/ Mandatory
47	SUPPLEMENTARY PANEL PIXELS DOWN	Number of pixels vertically down the supplementary panel display area.	PR010	O
48	SUPPLEMENTARY PANEL POSITION X	The X-coordinate (horizontal) position of the supplementary panel measured from the bottom left of the sign's overall display area to the bottom left of the supplementary panel.	PR010	O
49	SUPPLEMENTARY PANEL POSITION Y	The Y-coordinate (vertical) position of the supplementary panel measured from the bottom left of the sign's overall display area to the bottom left of the supplementary panel.	PR010	O
50	NUMBER OF REFERENCE FULL-MATRIX SIGN LAYOUT	Provides the number of reference full-matrix VMS layout in the catalogue.	PR010	M
51[c]	FULL-MATRIX REFERENCE LAYOUT IDENTIFIER	Identifier of the full-matrix VMS reference layout used for rendering VMS content.	PR010	M
52	PRESENCE OF LANTERNS	Specifies if lanterns are added to the full-matrix VMS to highlight specifically important messages.	PR020	O
53	X MAX SIZE OF PICTOGRAM	Provides the maximum horizontal size of the display area (in pixels).	PR010	M
54	Y MAX SIZE OF PICTOGRAM	Provides the maximum vertical size of the display area (in pixels).	PR010	M

[a] The blocks 12 to 17 are repeated according to the number of pictogram elements comprised in the publication (block 11).

[b] For VMS, the content between blocks 19 to 48 is repeated according to the number of included VMS reference layout (block 18).

[c] For full-matrix VMS, the blocks 50 to 53 are repeated according to the number of included full-matrix reference layout (block 49).

[d] For VMS, the blocks 37 to 48 are repeated according to the number of included pictogram areas in VMS layout (page) (block 36).

A.6.3 Definition of the management messages

The IVS message structure and content that is derived from here above requirements is provided by Table A.49.

Table A.49 — The IVS management message structure and content

Block Number	Data Element	Description	Requirement	Optional/ Mandatory
M1	PROTOCOL VERSION	This data element identifies the protocol version according to existing standard.		M
M2	MESSAGE TYPE	Choice between "IVS end message" and "IVS cancel message".	MR060, MR070	M
M3	ORIGINATOR ID	Identifier of the ITS-S which is at the origin of the message.	SR010	M or O according to flow type
M4	GENERATION TIME	Timestamp of the message. Milliseconds elapsed since midnight January 1st 1970 UTC.	MR020	M

Table A.49 *(continued)*

Block Number	Data Element	Description	Requirement	Optional/ Mandatory
M5	AUTHORIZED CONTENT PROVIDER ID	Identifier of the authorized content provider. May indicate the responsibility level.	CR020	M
M6	AUTHORIZED SERVICE PROVIDER ID	Provides the ID of the service provider.	SR010	O
M7	GENERATION TIME	This data element provides the message generation time stamp.	CR100	M
M8	IVSM REFERENCE	Provides the reference of the already provided IVS message in order to end or cancel it.	CR030	M
M9	VALIDITY END TIME	Provides the validity end time applicable to the corresponding content message.	MR070	C (only for "end" message)

A.7 The ASN.1 description of the IVS messages

This subclause specifies ASN.1 type definitions and ASN.1 value definitions for the messages used by the IVS service.

Unaligned packed encoding rules (PER) as defined in ISO/IEC 8825-2 shall be used for encoding and decoding.

```
-
-- ASN.1 specification of ISO 17425
-- Based on R10
-- Version:  v1.0p4
--

ISO17425 -- { iso(1) standard(0) cits-ivs(17425) pdus(1) versio1(1) }
DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

--
-- ContentProviderIdentifier
--
ContentProviderIdentifier ::= SEQUENCE {
   authorization    UTF8String,
   contentProviderCountry Country, -- ISO 3166-1
   nationalContentProvider UTF8String
}

--
-- IvsPublication
--
IvsPublication ::= SEQUENCE {
   contentProviderIdentifier  ContentProviderIdentifier,
   defaultLanguage             Language,
   protocolVersion             INTEGER (0..127, ...),
   publicationTime             DATE-TIME
}

--
-- IvsCataloguePublication
--
IvsCataloguePublication ::= SEQUENCE {
       ivsPublication      IvsPublication
}

--
-- IvsContentPublication
```

```
--
IvsContentPublication ::= SEQUENCE {
   ivsCatalogueReferenced VersionedReference,
   content    SEQUENCE (SIZE(1..128, ...)) OF IvsContent
}

--
-- IvsContent
--
IvsContent ::= CHOICE {
   ivsContentCancel  IvsContentCancel,
   ivsContentEnd  IvsContentEnd,
   fullMatrixSignContent  FullMatrixSignContent,
   roadSignContent  RoadSignContent,
   vmsContent  VmsContent,
   ...
}

--
-- IvsGenericContent
--
IvsGenericContent ::= SEQUENCE {
   ivsContentGenerationTime      DATE-TIME
}

--
-- IvsContentCancel
--
IvsContentCancel ::= SEQUENCE {
   ivsGenericContent IvsGenericContent,
   cancelledContent Reference
}

--
-- IvsContentEnd
--
IvsContentEnd ::= SEQUENCE {
   ivsGenericContent IvsGenericContent,
   endedContent Reference,
   validityEndTime DATE-TIME OPTIONAL
}

--
-- IvsSignContent
--
IvsSignContent ::= SEQUENCE {
   ivsGenericContent     IvsGenericContent,
   ivsContentReferenced  Reference OPTIONAL,
   ivsMessageType        IvsMessageType,
   ivsPriorityOverride   BOOLEAN DEFAULT FALSE,

   forVehicleWithCharacteristicsOf SEQUENCE (SIZE(0..128)) OF VehicleCharacteristics,
   relevanceZone         GroupOfLocations,
   driverAwarenessZone   GroupOfLocations OPTIONAL,
   validitySpec          Validity
}

--
-- FullMatrixSignContent
--
FullMatrixSignContent ::= SEQUENCE {
   ivsSignContent   IvsSignContent,
   fullMatrixSign   FullMatrixSign
}

--
-- FullMatrixSign
--
FullMatrixSign ::= SEQUENCE {
   lanternsOn          BOOLEAN,
   layoutReference     Reference,
```

```
   picture             JPEGPicture,
   sequencingInterval  Seconds OPTIONAL
}

--
-- RoadSignContent
--
RoadSignContent ::= SEQUENCE {
   ivsSignContent   IvsSignContent,
   ignPictogram     SignPictogram
}

--
-- SignPictogram
--
SignPictogram ::= SEQUENCE {
   pictogramFlashing         BOOLEAN,
   pictogramInInverseColour  BOOLEAN DEFAULT TRUE,
   pictogramReference        Reference,
   presenceOfRedTriangle     BOOLEAN,

   vehicleDimension          VehicleDimension OPTIONAL,
   incline                   INTEGER OPTIONAL, - Percentage
   distanceBetweenVehicles   Length OPTIONAL,
   speedAttribute            Speed OPTIONAL,
   supplementaryPanel        SEQUENCE (SIZE(0..2)) OF SupplementaryPanel
}

--
-- VehicleDimension
--
VehicleDimension ::= SEQUENCE {
   length Length OPTIONAL,
   weight Weight OPTIONAL
}

--
-- SupplementaryPanel
--
SupplementaryPanel ::= CHOICE {
   supplementaryText       TextLine,
   supplementaryPictogram  SupplementaryPictogram,
  sectionAttribute         SectionAttribute
}

--
--
--
SupplementaryPictogram ::= SEQUENCE {
   pictogramFlashing   BOOLEAN,
   reference           Reference
}

--
-- SectionAttribute
--
SectionAttribute ::= SEQUENCE {
   section CHOICE {
      distance SEQUENCE {
        applicableDistance           INTEGER (0..999, ...),
        applicableDistanceQualifier  ApplicableDistanceQualifier DEFAULT from
      },
      startingPointDistance                    INTEGER (0..999, ...)
   },
   distanceUnit           LengthUnit
}

--
-- VmsContent
--
VmsContent ::= SEQUENCE {
```

```
   ivsSignContent  IvsSignContent,
   vms    SEQUENCE (SIZE(1..32)) OF Vms
}

--
-- Vms
--
Vms ::= SEQUENCE {
   messageSequencingInterval      Seconds OPTIONAL,
   referenceLayoutIdentifier      Reference,

   vmsMessage                     VmsMessage,
   textDisplayAreaSettings        TextDisplayAreaSettings OPTIONAL,
   pictogramDisplayAreaSettings   PictogramDisplayAreaSettings OPTIONAL
}

--
-- TextDisplayAreaSettings
--
TextDisplayAreaSettings ::= SEQUENCE {
   lanternsOn              BOOLEAN
}

--
-- PictogramDisplayAreaSettings
--
PictogramDisplayAreaSettings ::= SEQUENCE {
   pictogramDisplayAreaIndex INTEGER (0..16),
   lanternsOn                BOOLEAN
}


--
-- VmsMessage
--
VmsMessage ::= SEQUENCE {
   messageIndex                                  INTEGER(1..1024),
   textPictogramSequencingInterval  Seconds  OPTIONAL,
   timeLastSet                DATE-TIME,
   informationType            VmsMessageInformationType,
   pages                    SEQUENCE (SIZE(1..2)) OF VmsText,
   pictogramDisplayArea     SEQUENCE (SIZE(1..8)) OF VmsPictogramDisplayArea
}

--
-- VmsText
--
VmsText ::= SEQUENCE {
   pageNumber          INTEGER(1..2),
   verticalTextLayout  BOOLEAN DEFAULT FALSE,
   vmsTextLine         TextLine
}

--
-- VmsTextLine
--
TextLine ::= SEQUENCE {
   lineIndex  INTEGER (1..5),
   textLine   UTF8String,
   flashing   BOOLEAN,
   language   Language
}

--
-- VmsPictogramDisplayArea
--
VmsPictogramDisplayArea ::= SEQUENCE {
   pictogramDisplayAreaIndex     INTEGER(1..16),
   synchronizedSequencingWithTextPages  BOOLEAN,
   signPictogram                   SignPictogram
}
```

```
--
-- VehicleCharacteristics
--
VehicleCharacteristics ::= SEQUENCE {
   driverStatus   DriverStatus    OPTIONAL,
   fuelType       FuelType        OPTIONAL,
   loadType       LoadType        OPTIONAL,
   vehicleEquipement  VehicleEquipement  OPTIONAL,
   vehicleType  SEQUENCE (SIZE(1..32)) OF VehicleType OPTIONAL,
   vehicleUsage  VehicleUsage     OPTIONAL,

   -- to be completed
   grossWeightCharacteristics     SEQUENCE (SIZE(0..2)) OF WeightCharacteristics,
   heaviestWeightCharacteristics  SEQUENCE (SIZE(0..2)) OF WeightCharacteristics,
   heightCharacteristics          SEQUENCE (SIZE(0..2)) OF DimensionCharacteristics,
   lengthCharacteristics          SEQUENCE (SIZE(0..2)) OF DimensionCharacteristics,
   widthCharacteristics           SEQUENCE (SIZE(0..2)) OF DimensionCharacteristics,
   numberOfAxlesCharacteristics   SEQUENCE (SIZE(0..2)) OF NumberOfAxlesCharacteristics
}

--
-- WeightCharacteristics
--
WeightCharacteristics ::= SEQUENCE {
   comparisonOperator  ComparisonOperator,
  weight            Weight
}

--
-- DimensionCharacteristics
--
DimensionCharacteristics ::= SEQUENCE {
   comparisonOperator  ComparisonOperator,
   length          Length
}

--
-- NumberOfAxlesCharacteristics
--
NumberOfAxlesCharacteristics ::= SEQUENCE {
   comparisonOperator  ComparisonOperator,
   numberOfAxles    INTEGER (1..8)
}

-- ******************************************************

--
-- IvsCatalogue
--
IvsCatalogue ::= SEQUENCE {
   countryCode      UTF8String,
   validtyDate      DATE-TIME,
   catalogueElement SEQUENCE (SIZE(1..128)) OF IvsCatalogueElement
}

--
-- IvsCatalogueElement
--
IvsCatalogueElement ::= CHOICE {
   fullMatrixReferenceLayout  FullMatrixReferenceLayout,
   vmsReferenceLayout         VmsReferenceLayout,
   pictogramCatalogueElement  PictogramCatalogueElement,
   ...
}

--
-- FullMatrixReferenceLayout
--
FullMatrixReferenceLayout ::= SEQUENCE {
   presenceOfLaterns     BOOLEAN,
```

```
   xMaxSize            INTEGER(1..65536),
   yMaxSize            INTEGER(1..65536),
   pictogramDrawing      JPEGPicture
}

--
-- VmsReferenceLayout
--
VmsReferenceLayout ::= SEQUENCE {
   textDisplayCharacteristics   VmsDynamicCharacteristics OPTIONAL
}

--
-- PictogramCatalogueElement
--
PictogramCatalogueElement ::= SEQUENCE {
   xMaxPictoSize   INTEGER(1..128) DEFAULT 64,
   yMaxPictoSize   INTEGER(1..128) DEFAULT 64,
   pictogramDrawing  JPEGPicture,
   pictogramCode     PictogramCode
}

--
-- PictogramCode
--
PictogramCode ::= SEQUENCE {
   pictogramCategory     INTEGER(1..65536),
   pictogramDesignation  UTF8String,
   pictogramServiceCategory  INTEGER(1..128)
}

--
-- VmsDynamicCharacteristics
--
VmsDynamicCharacteristics ::= SEQUENCE {
   pictogramDisplayAreaIndex      INTEGER (0..15),
   numberOfPictogramDisplayAreas  INTEGER (1..32) OPTIONAL,
   presenceOfLanterns              BOOLEAN   OPTIONAL,
   pictogramDisplayCharacteristics  VmsPictogramDisplayCharacteristics
}

--
-- VmsPictogramDisplayCharacteristics
--
VmsPictogramDisplayCharacteristics ::= SEQUENCE {
   pictogramPixelsAcross   INTEGER (1..256) OPTIONAL,
   pictogramPixelsDown     INTEGER (1..256) OPTIONAL,
   positionAbsolute         PositionAbsolute OPTIONAL,
   pictogramPositionRelativeToText  PositionAbsolute OPTIONAL,
   pictogramPositionX      INTEGER (1..128) OPTIONAL,
   pictogramPositionY      INTEGER (1..128) OPTIONAL,
   pictogramPageSequencingCapable  BOOLEAN  OPTIONAL,
   vmsSupplementaryPanelCharacteristics   VmsSupplementaryPanelCharacteristics OPTIONAL
}

--
-- VmsSupplementaryPanelCharacteristics
--
VmsSupplementaryPanelCharacteristics ::= SEQUENCE {
   displayPanelWidth  INTEGER (1..64) OPTIONAL,
   panelPixelsAcross  INTEGER (1..128) OPTIONAL,
   panelPixelsDown    INTEGER (1..128) OPTIONAL,
   panelPositionX     INTEGER (1..128) OPTIONAL,
   panelPositionY     INTEGER (1..128) OPTIONAL
}


--
-- VmsTextDisplayCharacteristics
--
VmsTextDisplayCharacteristics ::= SEQUENCE {
```

```
   maxFontHeight    INTEGER (1..32) OPTIONAL,
   maxFontWidth     INTEGER (1..32) OPTIONAL,
   maxFontSpacing   INTEGER (1..32) OPTIONAL,
   maxNumberOfCharacters   INTEGER (1..32) OPTIONAL,
   maxNumberOfRows         INTEGER (1..8) OPTIONAL,
   maxNumberOfSequentialPages  INTEGER (1..16) OPTIONAL,
   minFontHeight    INTEGER (1..32) OPTIONAL,
   minFontWidth     INTEGER (1..32) OPTIONAL,
   minFontSpacing   INTEGER (1..32) OPTIONAL,
   textPageSequencingCapable  BOOLEAN  OPTIONAL,
   textPixelsAcross INTEGER (1..256) OPTIONAL,
   textPixelsDown   INTEGER (1..256) OPTIONAL,
   textPositionAbsolute  PositionAbsolute OPTIONAL,
   textPositionX    INTEGER (1..128) OPTIONAL,
   textPositionY    INTEGER (1..128) OPTIONAL,
   verticalTextFeature  BOOLEAN OPTIONAL
}

-- ******************************************************

--
-- Validity
--
Validity ::= SEQUENCE {
   validityStatus    ValidityStatus,
   validityTimeSpecification  OverallPeriod
}

--
-- OverallPeriod
--
OverallPeriod ::= SEQUENCE {
   overallStartTime  DATE-TIME,
   overallEndTime    DATE-TIME  OPTIONAL
}

Length ::= SEQUENCE {
   value   INTEGER (0..127, ...),
   unit    LengthUnit DEFAULT meters
}

Weight ::= SEQUENCE {
   value   INTEGER (0..127, ...),
   unit    WeightUnit DEFAULT tonnes
}

Speed ::= SEQUENCE {
   speed       INTEGER (0..255),
   speedUnit   SpeedUnit DEFAULT kilometersPerHour
}

DriverStatus ::= ENUMERATED { allDrivers, learnerDrivers }
FuelType      :: = INTEGER {
   battery(0),
   biodiesel(1),
   diesel(2),
   dieselBatteryHybrid(3),
   ethanol(4),
   hydrogen(5),
   liquidGas(6),
   lpg(7),
   methane(8),
   petrol(9),
   petrolBatteryHybrid(10)
} (0..10, ...)

LoadType ::= INTEGER {
   abnormalLoad(0),
   ammunition(1),
   chemicals(2),
   combustibleMaterials(3),
```

```
   corrosiveMaterials(4),
   debris(5),
   empty(6),
   explosiveMaterials(7),
   extraHighLoad(8),
   extraLongLoad(9),
   extraWideLoad(10),
   fuel(11),
   glass(12),
   goods(13),
   hazardousMaterials(14),
   liquid(15),
   livestock(16),
   materials(17),
   materialsDangerousForPeople(18),
   materialsDangerousForTheEnvironment(19),
   materialsDangerousForWater(20),
   oil(21),
   ordinary(22),
   other(23),
   perishableProducts(24),
   petrol(25),
   pharmaceuticalMaterials(26),
   radioactiveMaterials(27),
   refuse(28),
   toxicMaterials(29),
   vehicles(30)
} (0..30, ...)

ValidityStatus ::= ENUMERATED { active, definedByValidityTimeSpec, suspended }

VehicleEquipement ::= INTEGER {
   notUsingSnowChains(0),
   notUsingSnowChainsOrTyres(1),
   snowChainsInUse(2),
   snowChainsOrTyresInUse(3),
   snowTyresInUse(4),
   withoutSnowTyresOrChainsOnBoard(5)
 } (0..5, ...)

VehicleType ::= INTEGER {
   agriculturalVehicle(0),
   anyVehicle(1)
   articulatedVehicle(2),
   bicycle(3),
   bus(4),
   car(5),
   caravan(6),
   carOrLightVehicle(7),
   carWithCaravan(8),
   carWithTrailer(9),
   constructionOrMaintenanceVehicle(10),
   fourWheelDrive(11),
   highSidedVehicle(12),
   lorry(13),
   moped(14),
   motorcycle(15),
   motorcycleWithSideCar(16),
   motorscooter(17),
   other(18),
   tanker(19),
   threeWheeledVehicle(20),
   trailer(21),
   tram(22),
   twoWheeledVehicle(23),
   van(24),
   vehicleWithCaravan(25),
   vehicleWithCatalyticConverter(26),
   vehicleWithoutCatalyticConverter(27),
   vehicleWithTrailer(28),
   withEvenNumberedRegistrationPlates(29),
```

```
   withOddNumberedRegistrationPlates(30)
} (0..30, ...)

VehicleUsage ::= INTEGER {
   agricultural(0),
   commercial(1),
   emergencyServices(2),
   military(3),
   non-commercial(4),
   patrol(5),
   recoveryServices(6),
   roadMaintenanceOrConstruction(7),
   roadOperator(8),
   taxi(9)
} (0..9, ...)

IvsMessageType ::= INTEGER {
   immediateDangerWarningMessages(0),
   regulatroyMessages(1),
   trafficRelatedMessages(2),
   pollutionMessages(3),
   nonTrafficRelatedMessages(4)
} (0..4, ...)

LengthUnit ::= INTEGER {
   meters(0),
   kilometers(1),
   feetInches(2),
   miles(3)
} (0..3, ...)

WeightUnit ::= INTEGER {
   tonnes(0),
   shortTons(1),
   quintals(2)
} (0..2, ...)

SpeedUnit ::= INTEGER {
   kilometersPerHour(0),
   milesPerHour(1)
}  (0..1, ...)

Seconds ::= INTEGER (0..7)

ApplicableDistanceQualifier ::= INTEGER {
   from(0),
   until(1),
   onEitherSide(2)
} (0..2, ...)

VmsMessageInformationType ::= INTEGER {
   campaignMessage(0),
   dateTime(1),
   futureInformation(2),
   instructionOrMessage(3),
   situationWarning(4),
   temperature(5),
   trafficManagement(6),
   travelTime(7)
} (0..7, ...)

ComparisonOperator ::= INTEGER {
   equalTo(0),
   greaterThan(1),
   greaterThanOrEqualTo(2),
   lessThan(3),
   lessThanOrEqualTo(4)
} (0..4)

PositionAbsolute ::= INTEGER {
   atBottom(0),
```

```
   atTop(1),
   onLeft(2),
   onRight(3)
} (0..3)

Reference ::= SEQUENCE {
   identifier  INTEGER (0..4294967295),
   className   PrintableString
}

VersionedReference ::= SEQUENCE {
   identifier    INTEGER (0..4294967295),
   version       INTEGER (0..16),
   className     PrintableString
}

-- ********************************************************
-- ISO 3166-1
-- to be completed
Country ::= ENUMERATED {af, ax, al, dz, de, fr, us, jp, ...}

-- ISO 639-1: two-letter codes
-- to be completed
Language ::= ENUMERATED {de, fr, us, jp, ...}

-- ********************************************************
-- tbd

--
-- GroupOfLocations
--
GroupOfLocations ::= SEQUENCE {
}

JPEGPicture ::= OCTET STRING

END

--- ASN.1 syntax checked with MARBEN ASN.1 Value Editor
--
```

Annex B
(informative)

Profile 2

B.1 General

This Annex specifies a profile for the instantiation of the IVS Message based on the following standards:

— ISO/TS 19321 for the data dictionary;

— ETSI TS 102 894-2 for the common message header for application and facilities layer messages;

— ISO/IEC 8825-2 for the encoding rules.

This Annex specifies a profile for the instantiation of the IVS Service using broadcast service communication, using the following standards:

— ETSI EN 302 665 for the communications architecture;

— ETSI TS 103 097 for communications security;

— ETSI EN 302 636-4-1 for the networking layer;

— ETSI EN 302 636-5-1 for the transport layer;

— ETSI EN 302 663 for the physical and medium access layers.

This Annex contains references to requirements of the IVS Service in brackets “()”.

B.2 IVS communication service in the ITS communications architecture

The IVS services are part of the I2V services residing in the facility layer entity, and manage the generation, transmission, and reception of I2V messages. The generation of I2V message payload is triggered by ITS applications. The term I2V message refers to the facilities layer PDU as generated by the facilities layer; the term I2V payload refers to the applications layer ADU.

Figure B.1 illustrates a high level functional architecture of the I2V services within the ITS communication architecture, as specified in ETSI EN 302 665. Information and data from other entities of the facilities layer and external infrastructure based entities connected via the N&T/Access Layer are used in order to collect relevant information for generation of the IVS payload.

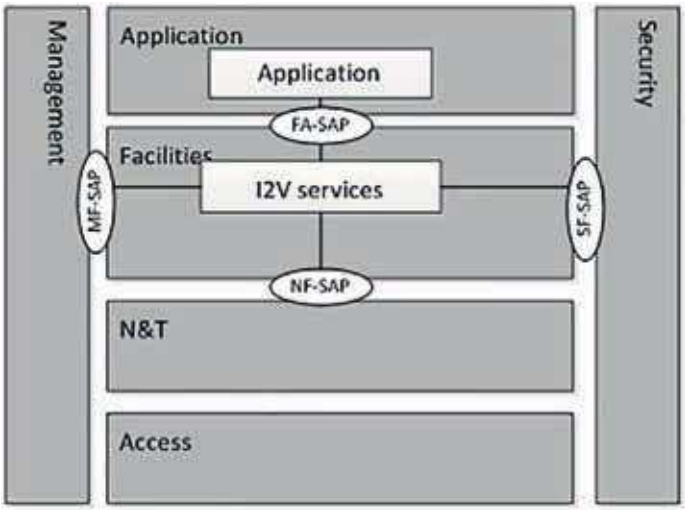


Figure B.1 — I2V basic service within the ITS-S architecture

The IVS basic service shall provide the following sub-functions:

a) encoding;

b) decoding;

c) transmission management;

d) reception management.

B.3 IVS message format

B.3.1 General

The IVI Structure of ISO/TS 19321 shall be contained in a larger structure and preceded by the ITS PDU Header of ETSI TS 102 894-2 to form the IVS Message. This is indicated by the following ASN.1 structure:

```
IvsMessage:: = SEQUENCE {
   header  ItsPduHeader,
   ivi       IviStructure
}
```

The ITS PDU header is a common header that includes the information of the protocol version (GR 060), the message type ("IVI"), and the ITS-S ID of the originating ITS-S, operated by the Service Provider.

Unaligned packed encoding rules (PER) as defined in ISO/IEC 8825-2 shall be used for encoding and decoding.

B.3.2 Use of IVI Management Container

The IVI Structure shall contain one Management Container.

The component serviceProviderId should identify the Content Provider (CR020).

The components: iviIdentificationNumber, timestamp, and iviStatus should be handled as follows in accordance to the message management requirements.

Table B.1 — Message management

Case	Requirement	iviIdentificationNumber	timestamp	IviStatus
1. New	— MR020 CR030	— New value	— Timestamp of generation	— "New"
2. Update of previous message	— MR030 MR040	— Same value as new	— Timestamp of update	— "update"
3. Repetition of previous message	— MR050	— Same value as new	— Same timestamp as previous	— Same status as original
4. Cancel	— MR060	— Same value as new	— Timestamp of cancelling	— "cancel"
5. End	— MR070	— Same value as new	— Timestamp of ending	— "update"

The component validFrom and validTo should contain information on the validity start time and, when available, information on the validity end time (CR090, MR080). ValidTo should be present in case of an End Message (MR070).

The component connectedIviStructures shall be absent.

B.3.3 Use of the Geographic Location Container

The IVI structure shall contain one or more geographic location container(s) in cases 1, 2, and 3 (see Table B.1).

NOTE In cases 4 and 5, the location container can be omitted at discretion of the Service Provider.

The geographic location container shall consist of (CR070) the following:

— the common content;

— 1 part describing the Driver Awareness Zone;

— for the Relevance Zone either:

  — 1 part describing the entire carriageway as a Relevance Zone, or

  — n parts describing the n lanes of the carriageway as single distinct parts of the entire Relevance Zone, if lane specific location information is available (CR080).

B.3.4 Use of the Application Container

The IVI Structure shall contain one or more application container(s) in cases 1, 2, and 3 (see Table B.1), as defined in this Annex.

NOTE In cases 4 and 5, the application container can be omitted at discretion of the Service Provider.

The general IVI Application Container shall be used to provide information on one or more road signs or the multi-part content of traffic Variable Message Signs (GR030). If lane-specific information is supported, as many container parts as different lane-specific information shall be used, plus optionally one part for information applicable to the entire carriageway. Road sign codes shall be transmitted using the ISO 14823 Code alternative of the roadSignCode component (CR010). The component iviType shall be handled according to the IVS message type (CR040). The extraText component shall be used to convey text with up to max. 32 characters including its alphabet indicator (CR050, CR100). The vehicleCharacteristics component shall be used to define limitations on applicability defined by vehicle characteristics, vehicle class, and vehicle usage (CR060, MR080). The driverCharacteristics component shall be used to define limitations on applicability defined by road user profile (CR060, MR080).

The Text Container shall be used to convey content that cannot be transferred using the general IVI Application Container. The Text component shall be used to convey text including its alphabet indicator (CR050, CR100). The Data component shall be used to convey the content of full-matrix signs or assimilated encoded as a compressed JPEG file (CR120).

The Layout Container shall be used to convey information about the potential layout of IVI (PR130, PR160).

The Road Configuration Container shall be used to convey the configuration of the road in terms of lanes, their type and status, if applicable.

B.4 Communication requirements for high priority broadcast service communication

The GeoNetworking protocol according to ETSI EN 302 636-4-1 and Basic Transport Protocol according to ETSI EN 302 636-5-1 shall be used to disseminate the IVS Message

The IVS application shall provide the MDA as destination area in the format compliant to the one as specified in ETSI EN 302 931 to the ITS networking and transport layer (CR020).

If the MDA is within direct communication range of the sending ITS-S, the Single Hop Broadcast protocol shall be used. If the MDA exceeds the direct communication range or is not within the direct communication range, the Topologically Scoped Broadcast or the Geographically-Scoped Broadcast protocol shall be used with a reasonable Maximum Hop Limit.

In case ITS G5 is used for CAM dissemination, the control channel (G5-CCH), as specified in ETSI EN 302 663, shall be used for dissemination.

The IVS message shall be signed according to ETSI TS 103 097 using the “Generic security profile for other signed messages” which includes the sending ITS-S certificate (MR010).

NOTE ITS-AID and SSP definition to be contained in the certificate will be provided in future releases of this Technical Specification.

Annex C
(informative)

Elements about static road signing

C.1 General considerations

(Source: Vienna convention on Road Signs and Signals)

Since the very beginning of road traffic, countries have regulated road signs and signals on a national point of view. These regulations have evolved and become more complex as time goes by.

The origins of international legislation on road traffic may be traced back to the International Convention on Motor Traffic concluded in Paris on 11 October 1909. The problems of motor vehicle construction, of admission to international traffic, and of signs and signals were already dealt with, as regards the essentials, in that Convention.

The Conference, which gathered together countries from the entire world, was held from 7 October to 8 November 1968 in Vienna and ended on 8 November with the opening ceremony for signature of the two texts adopted, namely: the Convention on Road Signs and Signals (E/CONF.56/17/Rev.1) and the Convention on Road Traffic (E/CONF.56/16/Rev.1). Thirty-one countries signed the Convention on Road Signs and Signals that day. The Convention entered into force on 6 June 1978 and has 56 Contracting Parties, at the date of 1 July 2007. These texts are regularly updated. This convention is often abbreviated in "Vienna convention".

For countries having signed and ratified these conventions it implies that the nationals regulations. It actually implies to:

— "*Where this Convention prescribes a sign, symbol or marking for signifying a certain rule or conveying certain information to road-users,*" the authorities in charge of road signing and traffic *"undertake, subject to the time-limits specified in paragraphs 2 and 3 of this Article, not to use any other sign, symbol or marking for signifying that rule or conveying that information;*[1)]

— "*Where this Convention does not prescribe a sign, symbol or marking for signifying a certain rule or conveying certain information to road-users, it shall be open*" to these authorities *"to use for these purposes any sign, symbol or marking they wish, provided that such sign, symbol or marking is not assigned a different meaning in this Convention and provided that it conforms to the system prescribed by this Convention"*.

C.2 Vienna convention categorization signs examples

The Vienna convention classifies road signs in several categories, every category having specific shapes, colours, and rules. These categories are the following:

— A Danger warning signs;

— B Priority signs;

— C Prohibitory or restrictive signs;

— D Mandatory signs;

— E Special regulation signs;

1) Texts in italics are extracted from the convention text itself.

— F Information, facilities, or service signs;

— G Direction, position, or indication sign;

— H Additional panels.

Figure C.1 presents some examples of such road signs among the previous categories.

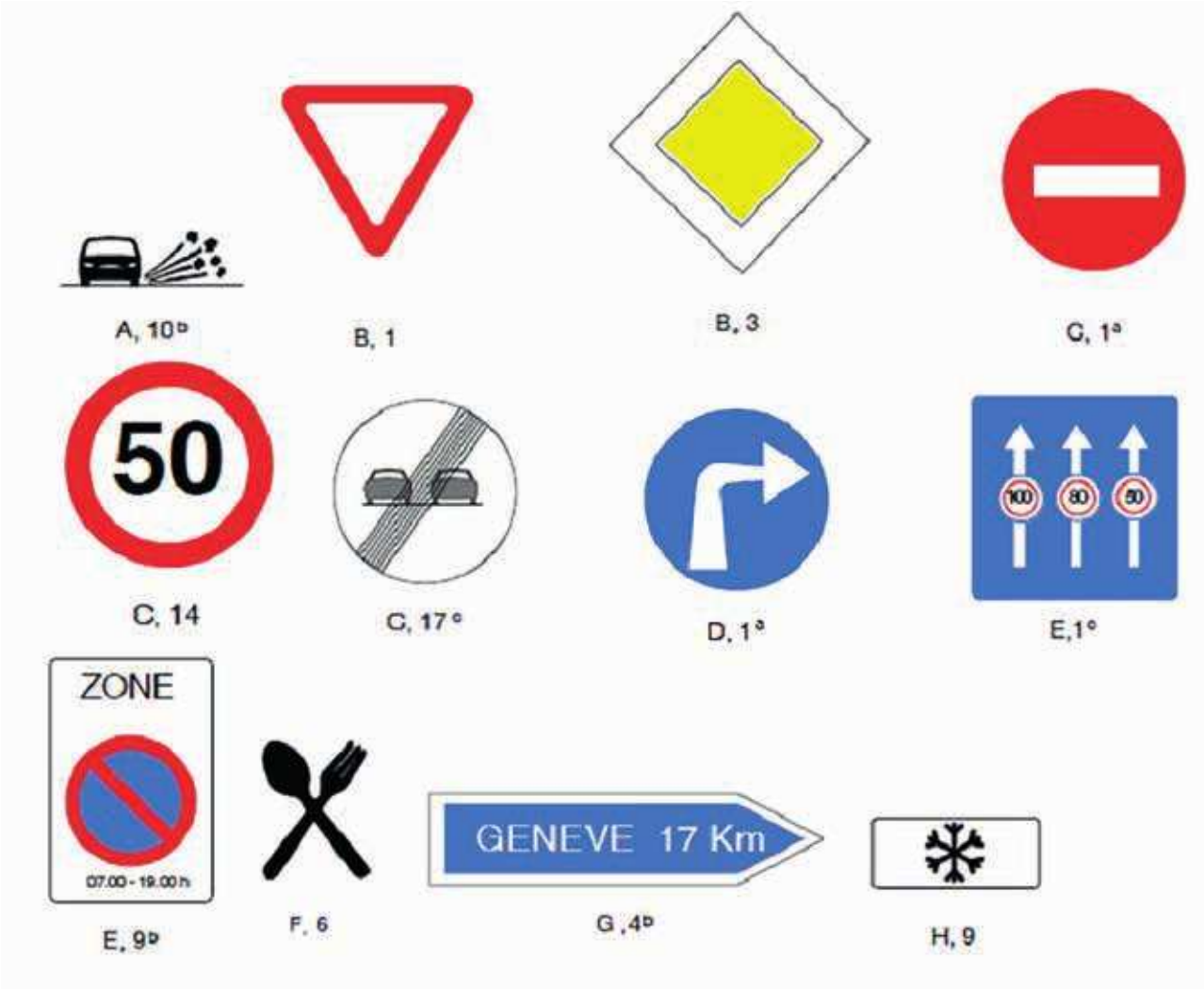


Figure C.1 — Example of roads signs from the Vienna convention

Annex D
(informative)

Different technologies and layouts used in VMS

This Annex gives informative design examples of variable message signs. Since the layout of the signs is not normative, dependent on local needs, traffic managers can have their own design.

Signs comprise coloured backgrounds with contrasting coloured symbols. For light emitting signs, the Vienna Convention on Road Signs and Signals allows colour inversion. Traffic managers have different requirements concerning inversion. Some require inversion, some allow inversion, and some do not allow it. Examples of non-inverted and inverted design issues are included in this Annex.

The symbol designs also can be based on non-matrix systems, such as circles, arcs, and even free forms. Examples of some of these different matrix systems are shown in this Annex.

Colour inversion: In order to be clearly distinguished from the coloured border, the symbol to be inscribed within a black “symbol area” requires a minimum clearance between the border and the symbol itself (see Reference [11]).

This large diversity in technology and design used in the types of VMS is presented hereafter:

— Warning and/or regulatory signs used in lane-control systems

Figure D.1 — Warning and/or regulatory signs example

— Text-only VMS with generally 2-3 lines of text

Figure D.2 — Text-only variable message sign

— Text VMS with a pictogram area on the left side

Figure D.3 — Example of a VMS with one pictogram left

— Text VMS with 2 pictogram areas on the left side

Figure D.4 — Example of a text VMS with two pictograms left

— Text VMS with a pictogram area on both sides

Figure D.5 — Example of a text VMS with one pictogram on each side

— Full matrix panels, which can display bitmaps

Figure D.6 — Full-matrix panel VMS example

— Rotating prism VMS often used for directional signing

Figure D.7 — Rotating prism VMS example

Annex E
(informative)

Topology of the relevance zone of the different road signs

Table E.1 provides the default topology of the relevance zone associated to different road signs defined in the "Convention on road signs and signals" of 1968. This topology by default can be a point (zero-dimensional element - indeed a road section of very small length like a junction), a linear (one-dimensional feature defined as a sequence of one or more edges, i.e. road section of appreciable length) or an area (two dimensional feature enclosing a set of connected road sections). For quite every case, this topology can be modified using additional panels.

NOTE 1 These definitions comply with ISO 14825.

NOTE 2 It is not allowed defining relevance zone implicitly or conceptually (like "on motorways" or "on the ring road") because it needs to be attached to geographic features.

Table E.1 — Road signs and relevance zone

Type	Code	Meaning	RZ[a]	Application conditions	Other descr. attr.	Comment
Danger warning	A1	Dangerous bend or bends	P/L	May be completed by a relevance zone	—	Set of 4 signs (2 on point and 2 linear)
	A2	Dangerous descent	L	May be completed by advice (e.g. "use engine brake")	Gradient percentage	
	A3	Steep ascent	L	May be completed by advice	Gradient percentage	
	A4	Carriageway narrows	P	May be completed by a relevance zone	—	
	A5	Swing bridge	P		—	
	A6	Road leads on to quay or river bank	P		—	
	A7	Uneven road	P/L	May be completed by a relevance zone	—	Set of 3 signs
	A8	Dangerous shoulders	L	May be completed by advice	—	
	A9	Slippery road	L	May be completed by conditions or advice	—	
	A10	Loose gravel	L		—	
	A11	Falling rocks	L	May be completed by conditions or advice	—	
	A12	Pedestrian crossing	P	May be completed by a relevance zone (or crossings number)	—	
	A13	Children	L	May be completed by conditions or advice	—	

[a] For RZ: P means "point", L means "linear", and A means "area".

Table E.1 *(continued)*

	A14	Cyclists entering or crossing	P		—	
	A15	Cattle or other animals crossing	L		—	Set of 2 signs (cattle and wild). May be completed by national variants.
Danger warning	A16	Road works	L	May be completed by indications	—	
	A17	Light signals	P	May be completed by a relevance zone (or intersections number)	—	Set of 3 signs according to national specificities
	A18	Intersection where the priority is prescribed by the general priority rule	P		—	Set of 7 signs according to national specificities
	A19	Intersection with a road the users of which must give way	P		—	Set of 3 signs
	A20	Intersection with a road to whose users drivers must give way	P		—	
	A21	Intersection with a road to whose users drivers must give way ("STOP")	P		—	Set of 2 signs according to national specificities
	A22	Roundabout	P		—	
	A23	Two-way traffic	L	Can be completed by a pre-announcement	—	Position signage
	A24	Traffic congestion	L		—	
	A25	Level-crossings with gates	P		—	
	A26	Other level-crossings	P		—	Set of 2 signs according to national specificities
	A27	Intersection with a tramway line	P		—	
	A28	immediate vicinity of level-crossings	P		—	Position signage

[a] For RZ: P means "point", L means "linear", and A means "area".

Table E.1 *(continued)*

	A30	Airfield	L	May be completed by indications	—	
	A31	Cross-wind	L	May be completed by indications or advice	—	
	A32	Other dangers	P/L	Generally completed by indications		
	B3	Priority road	L			Position signage
	other	Other priority signage	P			Position signage (set of 5 different signs)
	C1	No entry	L	Limitation or exception (type vehicle, date/time, special services, or users) through panels		Example of services: Public transports, emergency, refuse, residents, local traffic
	C2	Closed to all vehicles in both directions	L	Limitation or exception (type vehicle, date/time, special services, or users) through panels		idem
	C3	No entry for a category of vehicle/load	L	Limitation or exception (type vehicle, date/time, special services or users) through panels	Vehicle type Load type	Set of 14 road signs applicable for one type of vehicle as well as to a specific type of loads (explosive materials, causing water pollution)
	C4	No entry for several categories of vehicles	L	Limitation or exception (type vehicle, date/time, special services, or users) through panels	Vehicle types	May contain 2 (or rarely 3) types of vehicles/ users
	C5	No entry for vehicles having an overall width exceeding .. metres	P/L		Width	Generally applicable at a point (e.g. bridge or tunnel) and presigned at the beginning of the corresponding road section
	C6	No entry for vehicles having an overall height exceeding .. metres	P/L		Height	Applicable at a point (e.g. bridge or tunnel) on a road section
	C7	No entry for vehicles exceeding .. tonnes laden mass	P/L	Some restriction like local traffic	Laden mass	Generally applicable at a point (e.g. bridge or tunnel) and presigned at the beginning of the corresponding road section
	C8	No entry for vehicles having a mass exceeding .. tonnes on one axle	P/L	Some restriction like local traffic	Mass by axle	Generally applicable at a point (e.g. bridge or tunnel) and presigned at the beginning of the corresponding road section

[a] For RZ: P means “point”, L means “linear”, and A means “area”.

Table E.1 *(continued)*

Prohibition or restriction	C9	No entry for vehicles or combinations of vehicles exceeding .. metres in length	L/P	Possible restrictions	Length	
	C10	Driving of vehicles less than ... metres apart prohibited	L	Possible restrictions	Distance	Frequent in tunnels
	C11	No left/ right turn	P (L)	Limitation or exception (type vehicle, date/time, special services, or users) through panels		May be applicable on several consequent junctions (panel)
	C12	No U-turn	P (L)	Limitation or exception [type vehicle, date/time, impacted lane(s)] through panels		May be applicable on several consequent junctions (panel)
	C13	Prohibition of overtaking	L	Limitation or exception (type vehicle, date/time, trailers, weather) through panels		In case for good vehicles without any panel above 3.5 t
	C14	Maximum speed limited to the figure indicated	L	Limitation or exception (type vehicle, date/time, trailers) through panels	Maximum speed	May combine several values with different panel(s)
	C15	Use of audible warning devices prohibited	A/L	On a given length when not applicable to the whole built-up area		
	C16	Passing without stopping prohibited	P			Applicable for customs, police, tollbooths
	C17	End of prohibition or restriction	L			Linked to C13 or C14 - C17a means “end of all local prohibitions”. For speed limits the generic speed limits apply again
	D1	Direction to be followed	P			Linked to navigation. Several directions may be given
Mandatory signs	D7	Compulsory minimum speed	L		Minimum speed	
	D8	End of compulsory minimum speed			Minimum speed	Linked to D7

[a] For RZ: P means “point”, L means “linear”, and A means “area”.

Table E.1 *(continued)*

	D9	Snow chains compulsory	L	Possible limitation in time		
	D10	Compulsory direction for vehicle carrying dangerous goods	P	Possible limitation in time or vehicle types		Several directions possible
Special regulation signs	E1a or b	Compulsory minimum speed applying to one or several lanes	L		Minimum speed	Applicable lane(s)
	E1c	Speed limits applying to different lanes	L		Maximum speed	Applicable lane(s)
	E5a	Motorway	L			Generally implies a different generic speed limit
	E5b	End of motorway	L			Generally implies a different generic speed limit
	E6a	Road for motor vehicles	L	Possible restrictions/ allowances		May have no impact on generic speed limit
	E6b	End of road for motor vehicles	L			May have no impact on generic speed limit
	E7	Beginning of built-up area	A			Implies a different generic speed limit
	E8	End of built-up area	A			Implies a different generic speed limit
	E9d	Maximum speed zone	A		Maximum speed	
	E10d	End of maximum speed zone	A		Maximum speed	Implies a generic speed limit
	E17a	Residential area	A		Maximum speed	Implies a dedicated generic speed limit (sometimes written on the sign)
	E17b	End of residential area	A		Maximum speed	Implies a generic speed limit
Indic.	G17	Advisory speed	L		Advisory speed	There is no “End of advisory speed limit” but some countries have created such signs

[a] For RZ: P means “point”, L means “linear”, and A means “area”.

Annex F
(informative)

Elements of data modelling using UML

This Technical Specification makes use of a methodology to express a structural definition of the DATEX II data model called UML. The following table shows a short description of UML diagram elements used to ensure that no misinterpretation may occur caused by on-going development of UML. UML 1.4 is standardized in ISO 19501.

Table F.1 — Descriptions of UML diagram elements

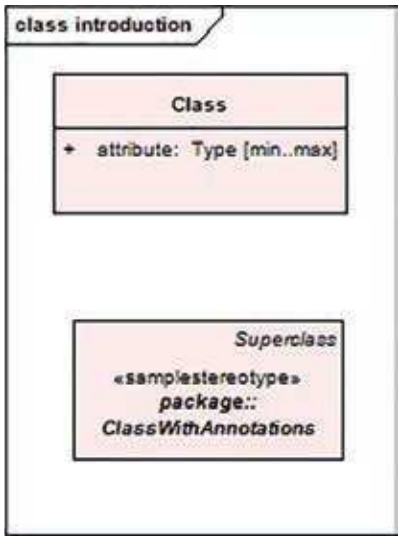
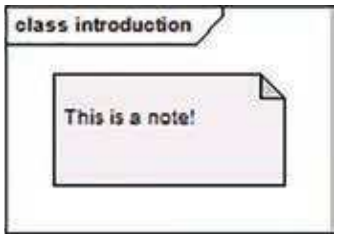
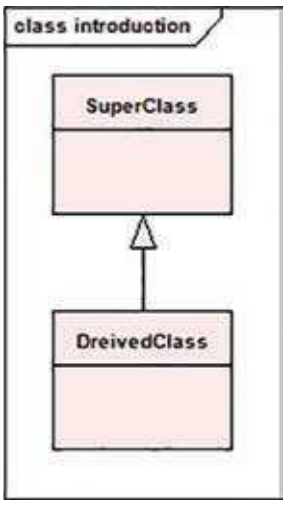
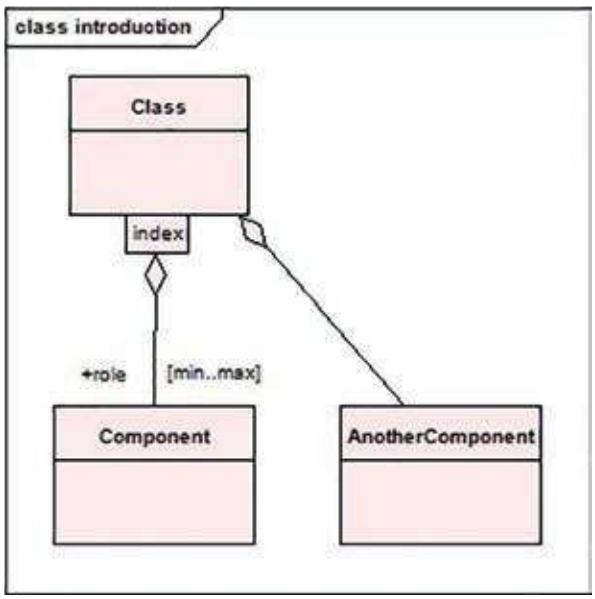
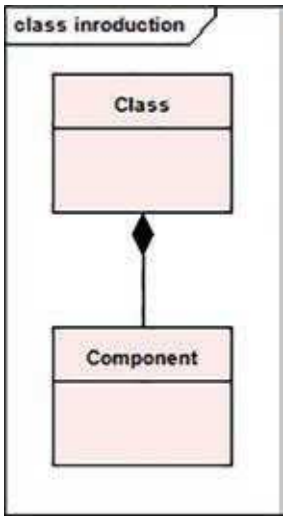
Element Name	Element	Description
Class		A class is a template for a given data element which can contain attributes. It is a rectangle divided into two compartments. The upper compartment contains the name of the class and the lower compartment contains a list of attributes owned by that class. In some diagrams, the bottom compartment of attributes may be omitted for clarity reason. An attribute line has a specifier "+, #, or –" for the visibility (not used in this Technical Specification), a name of the attribute and after a colon a data type, and in squared brackets, the multiplicity (which is described in more detail in aggregation hereunder). The second class in the example depicts a class with additional metadata mark-up. This includes a <<stereotype>> assigned to the class, a package prefix for a class that is not defined in the package where the diagram is, a quote of a superclass that the class is specialized from, and it shows that names of abstract classes (i.e. classes that cannot be instantiated) are set in italics. Note that class names sometimes have a ∞ in their lower right corner, which is not a feature of UML but of the tools that the classes have been created with.
Notes		Note-box is used in the diagrams to indicate a normative restriction or condition that cannot be indicated by UML standard notation. A note can apply to one or more classes or relations. Sometimes a Note-box is used for extra information e.g. to tell what an "index" is (see section on Aggregations below).
Specialization/ Generalization		A Specialization (i.e. Inheritance) defines the relationship of a specialized a general class (derived class) whose properties are inherited from a more general class (super class). In terms of data structures, this implies that the derived class has at least the same attributes as the super class and normally will extend the state definition of the class with more attributes. The reason for using inheritance often is the capability of having different specializations from one super class. Generalization is a different name for the same relationship seen in reverse order, i.e. from the more specialized towards the more general class.

Table F.1 *(continued)*

Element Name	Element	Description
Aggregation		The aggregation describes an owner/component relationship. The class on the side of the diamond "has" an instance of the aggregated class. The name of that instance ("role name") is given on the left side of the connection and starts again with the "+" as a specifier of visibility. On the right side, the multiplicity of that instance is given as a range of the allowed count of occurrences. Optionally, the component can be addressed by an index which provides the means for the aggregation to refer to the owned element. Role, index, and multiplicity are optional element, as the second depicted aggregation demonstrates.
Composition		The composition strengthens the type of aggregation in a way that the lifetime of the composed element is the same as the composing class, i.e. the structure can be seen as a "composition". In data structures, composition is normally seen as an embedded data element. Such a component can't live outside the composite.

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ICS 03.220.01; 35.240.60

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