Technical Specification

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Intelligent transport systems — Cooperative ITS — Dictionary of in-vehicle information (IVI) data structures

Systèmes intelligents de transport — Coopérative STI — Dictionnaire de structures de données d'informations dans les véhicules (IVI)

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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 document 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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Intelligent transport systems,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO/TS 19321:2020), which has been technically revised.

The main changes are as follows:

— additional explanations have been added in 5.2.2;

— the Infrastructure Support Container and related data frames and data elements have been added;

— the data frame `SegmentExtended` has been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In a cooperative intelligent transport system (C-ITS), presenting information related to the traffic situation or regulation of a road to the driver of a vehicle is an important component of road operations. The road operators are responsible for road setup, operation, signage and maintenance for traffic management and road safety, and in some countries, also for the enforcement of road laws. For road operators, efficient transport of vehicles on roadways ensures a safe and predictable trip for all road users. Road operators, together with equipment manufacturers, whether of vehicles or of roadside equipment, contribute to how road information is properly presented to drivers.

So far, one defined C-ITS method for notifying road users of road and/or traffic situations and events is by transmission of messages such as Cooperative Awareness Messages (CAM), Decentralized Environment Notification Messages (DENM) or Basic Safety Messages (BSM).

This document supports mandatory and advisory road signage such as contextual speeds and road works warnings. In-vehicle information can be sent by an ITS station (ITS-S) and either corresponds to physical road signs such as static or variable road signs or does not correspond to physical road signs (a virtual sign), or corresponds to road works. In-vehicle information (IVI) does not include identification of road events as already provided by DENM.

This document provides a toolbox of information elements for IVI. It can be used for fulfilling the requirements of the service provider considering the needs of the receiving ITS-S. The container concept provides a way for an ITS-S to manage the relevant IVI information, determine where the IVI is relevant, and to provide details for the application of the IVI. The description of data elements encompasses the data syntax and semantics, i.e. a definition of data format and content, together with a description of how to use those data elements.

This document is of an enabling nature. It does not specify which information is necessary for a certain service, but it supports those IVI information elements that it can be necessary to transmit to a receiving ITS-S to carry out a certain service. Usage of the IVI information elements depends on the specific context and application of IVI for a specific service. Usage is established as mandatory or optional only for messaging purposes, not for application purposes. In order to fulfil the requirements of a specific service, the IVI structure can be appropriately profiled.

This document refers to ISO 14823-1 as one system of standardized codes for existing road signs codes.

NOTE ISO 14823-1 does not contain codes for specific national or regional signs that are not commonly used, and it does not represent a catalogue of road sign pictograms for all applicable nations.

Intelligent transport systems — Cooperative ITS — Dictionary of in-vehicle information (IVI) data structures

1 Scope

This document specifies the in-vehicle information (IVI) data structures that are required by different intelligent transport system (ITS) services for exchanging information between ITS stations (ITS-S). A general, extensible data structure is specified, which is split into structures called containers to accommodate current-day information. Transmitted information includes IVI such as contextual speed, road works warnings, vehicle restrictions, lane restrictions, road hazard warnings, location-based services and re-routing. The information in the containers is organized in sub-structures called data frames and data elements, which are described in terms of their content and syntax.

The data structures are specified as communications-agnostic. This document does not provide the communication protocols. This document provides scenarios for usage of the data structure, e.g. in case of real time, short-range communications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 639:2023, *Code for individual languages and language groups*

ISO 14823-1, *Intelligent transport systems — Graphic data dictionary — Part 1: Specification*

ISO 17573-3, *Electronic fee collection — System architecture for vehicle-related tolling — Part 3: Data dictionary*

ETSI/TS 102 894-2, *Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary; Release 2*

SAE J2540/2, *International Traveler Information Systems (ITIS) Phrase Lists*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
application data unit
data unit exchanged between ITS station application instances

3.2
container
group of *data frames* (3.4) and *data elements* (3.3) semantically belonging together in one place in the *in-vehicle information* (3.8) structure

3.3
data element
data type that contains one single datum

[SOURCE: ETSI/TS 102 894-2]

3.4
data frame
data type that contains more than one *data element* (3.3) in a predefined order

[SOURCE: ETSI/TS 102 894-2]

3.5
detection zone
part of the road network that is passed by a vehicle in approach of the *relevance zone* (3.16)

3.6
digital map database
structured set of digital and alphanumeric data portraying geographic locations and relationships of spatial features

[SOURCE: ISO 17572-1:2022, 3.9, modified — Note 1 to entry has been removed.]

3.7
driver awareness zone
parts of the road network in which a message is presented to inform drivers about upcoming situations

3.8
in-vehicle information
information contained in the in-vehicle information data structure that is required by different intelligent transport system services

3.9
in-vehicle signage
intelligent transport system service that provides static, as well as dynamic, road sign and message sign information to drivers

3.10
intersection
crossing and/or connection of two or more *roads* (3.14)

[SOURCE: ISO 17572-1:2022, 3.16, modified — Notes to entry have been removed.]

3.11
link
direct topological connection between two nodes in a given *digital map database* (3.6), that has a unique *link ID* (3.12)

[SOURCE: ISO 17572-1:2022, 3.19, modified — Admitted term “edge”, domain "<ITS> and Note 1 to entry have been removed. The phrase "that has a unique link ID" has been moved to the end of the definition.]

3.12
link ID
link identifier
[locally, globally] identifier that is uniquely assigned to a *link* (3.11)

[SOURCE: ISO 17572-1:2022, 3.20, modified — Preferred term and admitted term have been exchanged. Note 1 to entry has been removed.]

3.13
minimum dissemination area
parts of the road network where the *in-vehicle signage* (3.9) message can be received by the potentially targeted vehicles

3.14
road
part of the road network which is generally considered as a whole and which can be addressed by a single identification like a road name or road number throughout

[SOURCE: ISO 17572-1:2022, 3.36, modified — Notes 1 and 2 to entry have been removed.]

3.15
road segment
part of a *road* (3.14), having its start and end along that road

[SOURCE: ISO 17572-1:2022, 3.40, modified — Note to entry has been removed.]

3.16
relevance zone
parts of the road network for which the information in an Application Container is valid

3.17
road works warning
alert for routing road users around road construction and/or road repair

3.18
variable message sign
electronic sign board presenting text, symbols, or a combination of both

4 Abbreviated terms

AVC	Automated Vehicle Container
ASN.1	Abstract Syntax Notation One
BLOB	data binary large object
C-ITS	cooperative intelligent transport systems
DE	data element
DENM	decentralized environmental notification message
DF	data frame
GIC	General IVI Container
GLC	Geographic Location Container
ID	identification
ISC	Infrastructure Support Container
ITS	intelligent transport systems
ITS-S	ITS station
IVI	in-vehicle information
IVS	in-vehicle signage

LAC	Layout Container
MAP	map data message
MLC	Map Location Container
PDU	protocol data unit
RCC	Road Configuration Container
RSC	Road Surface Container
RWW	road works warning
TC	Text Container

5 In-vehicle information data structure

5.1 Structural model

5.1.1 General model

The in-vehicle information (IVI) structure represents the application data unit to be transmitted and received by an ITS station (ITS-S). The IVI structure shall conform to the syntax defined in Annex A as the data type `IviStructure`. This means that it shall be composed of Containers defined in this document and it shall follow the form depicted in Figure 1.

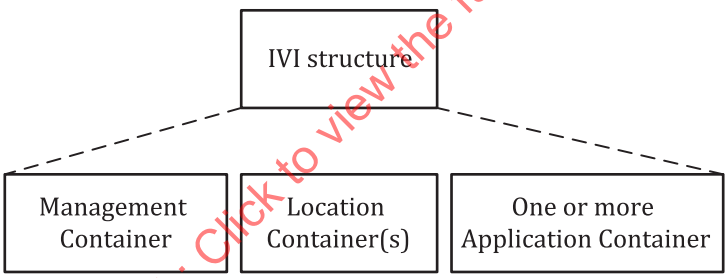

Figure 1 — IVI structure

The IVI structure is extensible and other Containers can be added in the future.

The IVI structure is intended to be encapsulated in a message with the appropriate ITS common header, for example, the `ItsPduHeader` of ETSI/TS 102 894-2. The header structure and contents are out of the scope of this document and are specified in ETSI/TS 103 301, for example.

The IVI structure shall contain a Management Container. The information in the Management Container is applicable to the entire IVI structure. The presence of this Container is mandatory and it provides a receiving ITS-S with enough information to handle the IVI structure and decide on its further processing.

The IVI structure can contain one or more Location Container(s). The Location Container describes the essential information for applications in the receiving ITS-S. Applications can use the location information to understand how to apply information provided by Application Containers. Location Containers can carry information relevant for different Application Containers or carry the same content but expressed in different forms (see 5.2). This enables a receiving ITS-S to choose the appropriate location referencing system that the ITS-S supports.

The IVI Structure can contain one or more Application Container(s). The Application Container provides IVI information for use by an application. Application information is self-contained and refers to the location information for its spatial validity. Application information of the same type shall not refer to overlapping

relevance zones. Each Application Container refers to zones defined in the Location Container identified by their identifications (IDs) for the following usage:

a) detection zone,

b) relevance zone, and

c) driver awareness zone.

An Application Container may optionally provide information about the minimum awareness time, that is, the minimum time for which the IVI should be available before the vehicle enters the relevance zone. This `MinimumAwarenessTime` information can be used by the receiving ITS-S to determine the appropriate driver awareness zone.

5.1.2 Conceptual zones

When an ITS-S receives the IVI structure, the ITS-S can interpret the application information in the context of the appropriate location information. Principally, there are four conceptual zones:

a) minimum dissemination area;

b) detection zone;

c) driver awareness zone;

d) relevance zone.

The Minimum Dissemination Area refers to the minimum area where the IVI structure is disseminated by an ITS-S based on application requirements. The extension of the Minimum Dissemination Area is defined in the relevant application standards or specification(s) and is therefore out of scope of this document.

In some situations, a vehicle ITS-S needs to be able to detect whether or not it is approaching a relevance zone at a certain minimum time before it enters the relevance zone. This is, for example, to guarantee that the relevance zone is detected immediately at its entry (e.g. in case of a very small relevance zone) or to guarantee that the relevance zone is correctly detected (in case it is near to other road segments, e.g. parallel or on different altitude level). Therefore, a detection zone occurs in the approach to a relevance zone. In this way, if a receiving ITS-S moves through the detection zone, it can detect that it is approaching a relevance zone.

The IVI can be used to inform drivers about upcoming situations in a relevance zone. The driver awareness zone can be determined by the receiving ITS-S because the driver awareness zone can be based on the dynamic status of the receiving ITS-S and can depend on the presence of other higher priority information to be presented. Alternatively, the driver awareness zone can be provided by the sending ITS-S for usage by the receiving ITS-S.

The relevance zone covers the area where the information in the Application Container is applicable.

Examples of the detection and relevance zones for the spatial validity of the IVI Structure are illustrated in Figure 2. In traffic direction East (right-hand traffic), i.e. under the green middle barrier, the figure shows a detection zone and a relevance zone for a speed limit (80 km/h) under slippery road conditions, for the entire carriageway. The driver awareness zone can be physically overlapping with the detection zone (but is not necessarily equal in size). In traffic direction West, Figure 2 shows lane-specific detection and relevance zones for speed limits (80 km/h and 100 km/h) and lane closure (red X).

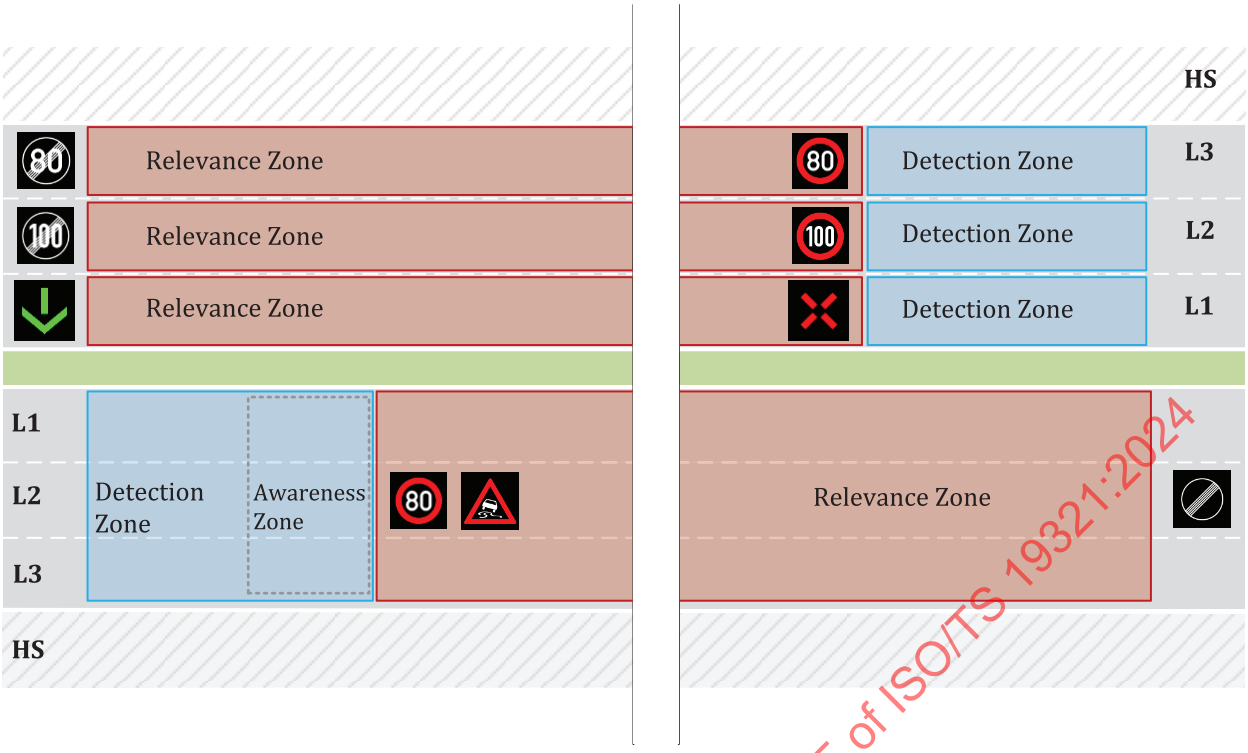

Figure 2 — Spatial validity for IVI: Detection and relevance zones

The Location Container always contains a definition of one or more zones which can represent a detection zone, a relevance zone, or both. In Figure 2 in traffic direction East, from left to right, the first zone represents a detection zone and the second zone represents a relevance zone.

In Figure 3 in traffic direction East, from left to right, the first zone represents a detection zone. The second zone then represents relevance zone 1, and this same zone also serves as a detection zone for relevance zone 2, and so on.

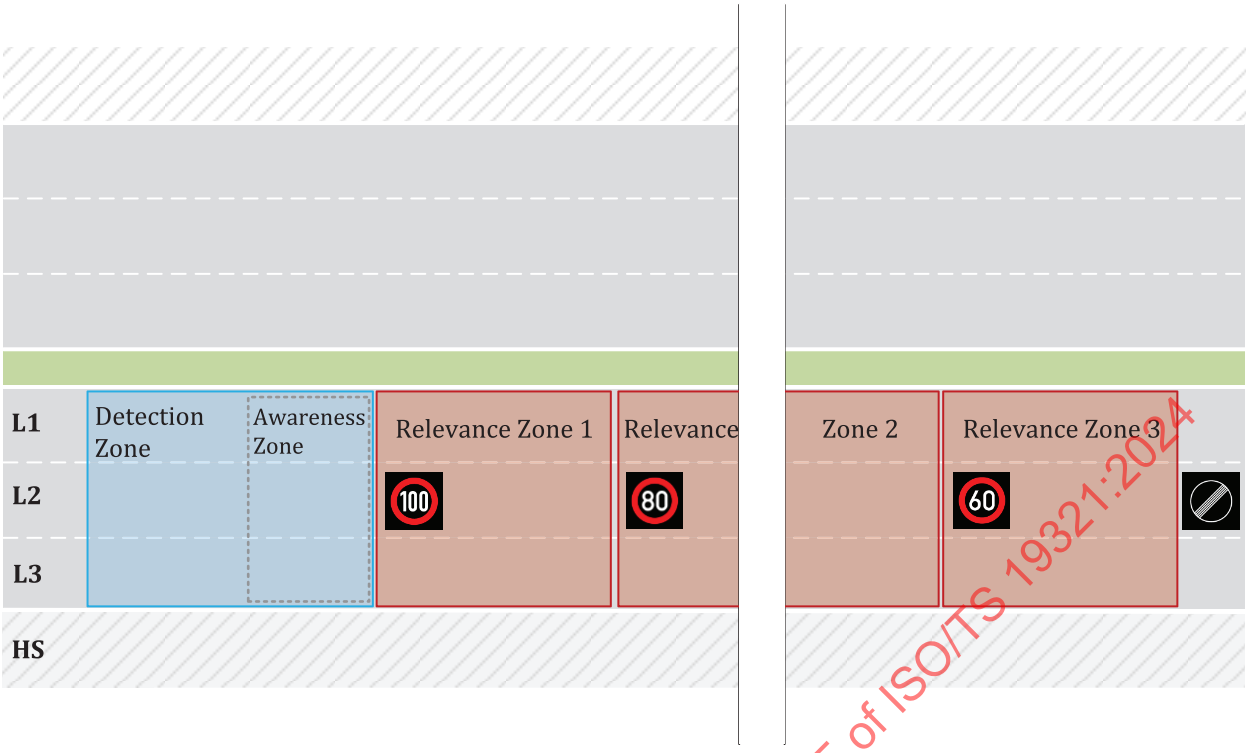

Figure 3 — Adjacent relevance zones

5.2 Location referencing

5.2.1 General

There are essentially two different ways of referencing road locations (see ISO 17572-1):

— geographic location referencing, when referencing a regular or irregular division of space which exists independently of the representation of the road network;

— map-based location referencing, when referencing attributes of the road network itself.

5.2.2 Geographic location referencing

Geographic location referencing systems are coordinate systems in a specified dimension (D) that provide means for expressing locations as D-tuples of individual coordinates.

An ITS-S sending an IVI Structure provides one or more common reference position(s) in the Geographic Location Container. The coordinate system in which a particular reference position is defined is specified implicitly. This reference position is the reference for the description of a static zone or a dynamic (moving) zone.

There are various options to describe a zone in the Geographic Location Container:

— a distance value indicating the extension of the zone from the reference position and the heading relative to the reference position (this is the simplest option);

— an area that includes a set of roads, described by a closed polygonal chain;

— a road segment characterized by a longitudinal extension or along track extension and a lateral extension or cross-track extension, described using one of the following options:

  — an open polygonal chain appropriately placed on the road and an implicitly defined lateral extension over all driveable lanes of the carriageway or of one driving direction. "Driveable lane" refers to

those lanes that are legally allowed for driving, including the regular driving lanes that are normally open for driving and optionally the (inner or outer) hard shoulder if it is opened for driving;

— an open polygonal chain appropriately placed on the road and an explicitly described lateral extension over a single lane. This allows the description of any physical lane, including regular driving lanes and inner or outer hard shoulders;

— an open polygonal chain appropriately placed on the road and an explicitly described lateral extension over a set of lanes. This allows the description of any set of parallel lanes, e.g. at a motorway junction the set of lanes that are exiting or the set that of lanes that are going straight.

Further zones can be described by referencing the common reference position or by referencing to (one of) the already described zone(s).

Determination of the relevance of IVI is carried out by referencing the location of a receiving ITS-S relative to the zone(s). As a vehicle progresses, its motion creates a series of points. The series, when assembled as a set, traces the path of the vehicle. The path enables a receiving ITS-S to locate itself with respect to the zone and to detect the applicability of a relevance zone and the approach into a relevance zone.

5.2.3 Map-based location referencing

This document supports map-based location referencing, by reference to a link ID in a digital map database (the "map"). The supported map is the Map Data Message (MAP) defined in ISO/TS 19091:2019. This can also be a MAP Extended Message as defined in ETSI/TS 103 301.

An ITS-S sending an IVI structure provides one or more references to Map Data Messages in the Map Location Container. The Map Data Message can represent an intersection: this is when the option `intersections` is used. Alternatively, the Map Data Message can represent a road segment: this is when the option `roadSegments` is used. The reference to the Map Data Message includes the type of option that is referred to.

A zone can be described with reference to one or more links defined in the Map Data Message. The link ID in such a message is called `LaneID`.

Determining the relevance of IVI is carried out by referencing the location of a receiving ITS-S relative to the links in the Map Data Message.

6 IVI Containers

6.1 Management Container

6.1.1 Definition

The Management Container contains information regarding the management of the IVI structure which supports the receiving ITS-S to deal with the lifecycle of the IVI. It includes information which allows receiving ITS stations to identify further processing. Table 1 describes the contents for inclusion in the Management Container. The syntax is defined in Annex A as a mandatory component of the data type `IviStructure` of type `IviManagementContainer`.

Table 1 — Management Container

Container	Component	M/O[a]	Description
IVI Management Container	`serviceProviderId`	M	Identifies the organization that provided the IVI by using the DF `Provider`.
	`iviIdentificationNumber`	M	Identifier of the IVI structure, as assigned by the Service Provider using the DE `IviIdentificationNumber`.
	`timeStamp`	O	Timestamp of the generation or last change of information content using the DE `TimestampIts` imported from ETSI/TS 102 894-2.
	`validFrom`	O	Start time of the validity period of the message using the DE `TimestampIts` imported from ETSI/TS 102 894-2.
	`validTo`	O	End time of the validity period of the message using the DE `TimestampIts` imported from ETSI/TS 102 894-2.
	`connectedIviStructures`	O	List of other `iviIdentificationNumber` identifying other IVI structures of the same authority which are connected to the IVI structure using the DF `IviIdentificationNumbers`.
	`iviStatus`	M	Status of the IVI Structure using the DE `IviStatus`.
Extension to the Management Container	`connectedDenms`	O	List of IDs of DENMs which are semantically connected to the IVI, using the DF `ActionIdList` imported from ETSI/TS 102 894-2.

[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.

6.1.2 Usage — Management Container

The Management Container shall include the components `serviceProviderId` and `iviIdentificationNumber`. It can also include the component `timeStamp`.

The `iviIdentificationNumber` in the Management Container is assigned by the service provider and should be retained as long as the IVI Structure exists throughout its various updates and changes.

NOTE 1 The organization providing the IVI (e.g. the Service Provider, as defined in ISO 17427-1) is uniquely identified by a `serviceProviderId`. The IVI Structure is uniquely identified by the combination of `serviceProviderId` and `iviIdentificationNumber`.

The component `timeStamp` should identify different versions of the IVI structure due to updates (including cancellations and negations, see `iviStatus`) managed by the service provider. This component should be included if the sending ITS-S foresees the sending of updates of the IVI structure.

The Management Container can include the components `validFrom` and `validTo`.

The Management Container shall include the component `iviStatus`.

The optional components `validFrom` and `validTo` indicate the overall validity of the IVI structure as provided by the service provider. If `validFrom` is not present, the IVI structure is valid when received. If `validTo` is not present, no information about the expiration of the information is given. In this case the IVI structure should be explicitly cancelled, see `iviStatus`.

A receiving ITS-S should check whether the status of the IVI structure is any one of the following:

— new, i.e. if the `iviStatus` is "new" or if the combination of `serviceProviderId` and `iviIdentificationNumber` is different from other received messages, or both;

— update of a received IVI structure, i.e. if the `iviStatus` is "update" or if the combination of `serviceProviderId` and `iviIdentificationNumber` is equal to those from another received structure and the timestamp is more recent, or both;

— duplicate of a received structure, i.e. if the combination of `iviStatus`, `serviceProviderId` and `iviIdentificationNumber` is equal to those from another received structure and also the timestamp is the same;

— cancellation, i.e. if the `iviStatus` is "cancellation";

— negation, i.e. if the `iviStatus` is "negation".

The definition of any actions for IVI handling based on the status and validity of the IVI structure is outside the scope of this document.

The service provider can divide the IVI into structures of appropriate size in relation to the capabilities of the communication technology and connect those IVI structures belonging together.

The Management Container can include the component `connectedIviStructures` to connect the IVI structure to other IVI structures provided by the same service provider that have been transmitted previously or by other ITS-Ss. In this case the service provider should maintain the consistency between the connected IVI structures when they are updated or cancelled.

EXAMPLE 1 In some situations, vehicles to which special regulations apply (such as heavy vehicles) need to observe national regulations rather than a specific contextual regulation in place (e.g. a limitation to 100 km/h due to congestion does not apply to heavy vehicles which are required to observe the national limit of 80 km/h). For this purpose, the IVI structure transmitted for contextual speed purposes can be connected to a different IVI carrying the national speed regulation in force for all vehicles.

Where the Container's extension is used, the Management Container can include the component `connectedDenms` to connect the IVI structure to DENMs (see ETSI EN 302-637-3) that provide information about the same situation.

EXAMPLE 2 A basic road works warning can be sent out using one or more DENM. More detailed information can be sent out using an IVI structure.

NOTE 2 The identification of the ITS-S (ITS-S ID) is not contained in the Management Container because it is protocol layer information which is contained, for example, in the ITS PDU Header. In addition, since the IVI structure can be signed at the service provider before transmission, it is not possible to add the ID of the sending ITS-S to the IVI structure.

6.2 Location Containers

6.2.1 General

The IVI structure can include several Location Containers. The Location Container contains information on the zones to support the Application Containers. This document supports the following Location Containers:

— the Geographic Location Container (GLC), as part of the root of the `IviContainer` data type defined in Annex A;

— the Map Location Container (MLC), as an extension to the `IviContainer` data type defined in Annex A.

Annex B provides visual examples of typical Location Container configurations.

6.2.2 Geographic Location Container

6.2.2.1 Definition

The GLC is built up of a common content that provides information about the common reference position and the repetition of *n* parts which define the zones.

The data elements for inclusion in the GLC are described in Table 2. The syntax is then defined in Annex A as the data type `GeographicLocationContainer`.

Table 2 — Geographic Location Container (GLC)

Container parts	Component	M/O[a]	Description
Common location Container content	`referencePosition`	M	The common reference position, i.e. any suitable position which serves as a potential reference for the Location Container arts in this Container, using the DF `ReferencePosition`.
	`referencePositionTime`	O	Time at which the reference position, if dynamic, was valid, using the DE `TimestampIts` imported from ETSI/TS 102 894-2.
	`referencePositionHeading`	O	Direction of the reference position, if dynamic, using the DF `Heading` imported from ETSI/ TS 102 894-2.
	`referencePositionSpeed`	O	Actual speed of the reference position, if dynamic, using the DF `Speed` imported from ETSI/TS 102 894-2.
Location Container part (*n* parts)	`zoneId`	M	Identifier of the definition of the zone, using the DE `Zid`.
	`laneNumber`	O	Identification of the lane represented by the Geographic Location Container part using the DE `LanePosition` imported from ETSI/TS 102 894-2.
	`zoneExtension`	O.1[b]	Extension of the zone as a circular area around the reference position in 10 m units.
	`zoneHeading`	O	Applicable heading of the zone, e.g. the effective direction of applicability of the sign, at the reference position, using the DE `HeadingValue` imported from ETSI/TS 102 894-2.
	`zone`	O.1	Definition of a zone using the DF `Zone`.

[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.

[b] Conditional Optional (O.1) shall be included in the Container if the other element O.1 is absent and shall be absent if the other element O.1 is present.

6.2.2.2 Usage

The IVI structure shall contain, in one or more of the GLC(s), the zones referred to by the Application Containers. All definitions of zones that are based on the same reference position, or that are referencing each other, should be included in the same GLC.

The GLC shall include the component `referencePosition` to describe the common reference position. The GLC can include the optional components `referencePositionTime`, `referencePositionHeading`, and `referencePositionSpeed` when describing a common reference position for a moving zone.

The GLC part shall include, for each zone, the component `zoneId`. This component shall be used by Application Containers to refer to the zone definition.

The GLC part shall include the optional component `laneNumber` for each zone if the zone definition is restricted to a specific lane. Otherwise, the component shall be absent.

The GLC part can include the component `zoneHeading` to support zone detection at the reference position based on the direction of applicability of the sign.

EXAMPLE A sign applicable to a deceleration lane of a highway can be better distinguished using the applicable heading at the beginning of such a lane rather than the definition of the zone (i.e. the lane) itself.

The GLC part shall include, for each zone, one of the following optional components to define the zone: the component `zoneExtension` or, alternatively, the component `zone`. For details about the various options to describe a zone using the component `zone`, see 7.2.31.

6.2.3 Map Location Container

6.2.3.1 Definition

The MLC is built up of a common content that provides the reference to a MAP and the repetition of *n* parts which define the zones with reference to the definition of lanes in the MAP.

The data elements for inclusion in the MLC are described in Table 3. The syntax is then defined in Annex A as the data type `MapLocationContainer`.

Table 3 — Map Location Container (MLC)

Container parts	Component	M/O[a]	Description
Common Location Container content	`reference`	M	Reference to a MAP, using the DF `MapReference` imported from ETSI/TS 102 894-2.
Location Container part (*n* parts)	`zoneId`	M	Identifier of the definition of the zone, using the DE `Zid`.
	`laneIds`	O	List of identifiers of links defined in the reference MAP message that constitute the zone, using the DF `LaneIds`.
[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.			

6.2.3.2 Usage

The IVI structure shall define, in one or more of the MLC(s), the zones referred to by the Application Containers, unless the zone definitions are provided in a GLC. All definitions of zones that are based on the same MAP, whether they are connected or not interconnected, should be included in the same MLC to achieve a more efficient coding.

The MLC shall include the component `reference` to provide the link to the MAP message.

The MLC part shall include, for each zone, the component `zoneId`. This component shall be used by Application Containers to refer to the zone definition.

The MLC part shall include the component `laneIds` for each zone, if the zone definition is restricted to specific link(s) defined in the MAP. If the zone definition applies to the entire set of links described in the referenced MAP, the component shall be absent.

6.3 Application Containers

6.3.1 General

The specific IVI information for a given situation can be found in one or more Application Containers. In this document, seven Application Containers are specified:

— the General IVI Container (GIC) for supporting services such as in-vehicle signage (IVS), contextual speeds, and road works warning (RWW), as part of the root of the `IviContainer` data type defined in Annex A;

— the Road Configuration Container (RCC) for transmitting the configuration of the road in terms of lanes, their type, and status, as part of the root of the `IviContainer` data type defined in Annex A;

— the Text Container (TC) for transmitting text and optionally, images, as part of the root of the `IviContainer` data type defined in Annex A;

— the Layout Container (LC) for conveying information about the underlying layout of IVI, as part of the root of the `IviContainer` data type defined in Annex A;

— the Automated Vehicle Container (AVC), as an extension to the `IviContainer` data type defined in Annex A;

— the Road Surface Container (RSC), as an extension to the `IviContainer` data type defined in Annex A;

— the Infrastructure Support Container (ISC), as an extension to the `IviContainer` data type defined in Annex A.

6.3.2 General IVI Container

6.3.2.1 Definition

The purpose for a General IVI Container is to provide information associated with fixed and dynamic road signs (e.g. matrix signs and parts of variable message signs) to support ITS services and their use cases like in-vehicle signage, contextual speeds, and road works warning. For descriptions of these use-cases, see Reference [11].

The data elements in the General IVI Container are described in Table 4. The syntax is then defined in Annex A as the data type `GeneralIviContainer`.

Table 4 — General IVI Container

Container parts	Component	M/O[a]	Description
General IVI Container part (*n* parts)	detectionZoneIds	O	List of identifier(s) of the definition(s) of the detection zone(s), using the DF ZoneIds.
	its-Rrid	O	Identifier of the ITS regulatory region to which the Container is applicable using the DE VarLengthNumber as imported from ETSI/TS 102 894-2.
	relevanceZoneIds	O	List of identifier(s) of the definition(s) of the relevance zone(s), to which the Container applies, using the DF ZoneIds.
	direction	O	Direction of relevance within the relevance zone(s) listed in the component relevanceZoneIds, using the DE Direction as imported from ETSI/TS 102 894-2.
	driver AwarenessZoneIds	O	List of identifier(s) of the definition(s) of the driver awareness zone(s), using the DF ZoneIds.
	minimumAwarenessTime	O	Time in tenths of seconds before the vehicle enters the relevance area, in which the IVI should be available as a minimum.
	applicableLanes	O	List of identifiers of the lane(s) to which the Container applies using the DF LanePositions.
	iviType	M	Priority of the Container information within the overall context of IVI. See DE IviType.
	iviPurpose	O	See DE IviPurpose.
	laneStatus	O	Status of the lane(s) to which the Application Container Part applies. See DE LaneStatus.
	vehicleCharacteristics	O	Vehicle characteristics for which the IVI is applicable. See DF VehicleCharacteristicsList. The applicable regulations, such as limits, are defined as part of the roadSignCode component.
	driverCharacteristics	O	Driver characteristics relevant for regulations. See DE DriverCharacteristics.
	layoutId	O	Identifier of the connected layout definition in the IVI structure using the type INTEGER(1..4,...).
	preStoredLayoutId	O	Identifier of a pre-stored layout definition using the type INTEGER(1..64,...).
	roadSignCodes	M	Ordered list of applicable road sign codes according to the selected catalogue, including additional attributes, using the DF RoadSignCodes. If present, an additional panel shall follow the sign to which it is associated.
	extraText	O	List of text lines associated to the ordered list of road sign codes. Each piece contains language code plus extra, limited-size text in the selected language using the DF ConstraintTextLines1.

[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.

6.3.2.2 Usage

The IVI structure can contain information associated with fixed and dynamic road signs in one or more General IVI Container parts. All parts that semantically belong together should be included in the same

Container (e.g. all parts belonging to the same situation such as a road works warning). The following provisions apply to each General IVI Container part.

a) The GIC part can include the identifier(s) for detection zone(s) in the component `detectionZoneIds`.

b) The GIC part shall include either the identifier(s) of a relevance zone in the component `relevanceZoneIds` or of an ITS regulatory region in the component `its-Rrid`, or both. If both components are present, the ITS regulatory region identifier points to the regulatory region definition and to the national regulations in place. If only the component `its-Rrid` is present, the ITS regulatory region identifier points to the regulatory region definition only.

c) The GIC part can include the component `direction` to describe the direction of relevance within a relevance zone representing a road segment, with respect to the direction associated to the segment. If the component `direction` is present, all relevance zones of type segment listed inside the component `relevanceZoneIds` shall have the same implicit direction.

d) For driver awareness purposes, the GIC part can include either the identifier(s) of recommended driver awareness zone(s) in the component `driverAwarenessZoneIds` or the recommended minimum awareness time in the component `minimumAwarenessTime` or none of those.

e) The GIC part can include the component `applicableLanes` to describe independently from information in the Location Container the lane(s) to where the information applies. This serves as a basis for correlating the information to a lane in case the location information does not support lane identification. If the information applies transversally to the entire relevance zone (all lanes), the component shall be absent.

f) The GIC part shall include the component `iviType` to provide a means to triage the IVI information based on degree of criticality. This does not provide prioritization over other relevant information such as those from CAMs or DENMs.

g) The GIC part can include the following optional components: `iviPurpose`, `laneStatus` `driverCharacteristics`, and `vehicleCharacteristics`. The component `laneStatus` describes special properties of the relevant lane(s) and can be used as an alternative to the Road Configuration Container. The `vehicleCharacteristics` indicates for which vehicles the information is applicable and can be used by the receiving ITS-S to filter out non-applicable Application Container parts.

h) The GIC part shall include the component `roadSignCodes` to specify which road signs are applicable for a relevance zone. Road sign codes are dependent on the referenced classification scheme. A sending ITS-S should select the road sign from a catalogue which is known to be supported by a receiving ITS-S. Additional attributes to the road sign code can be added as provided for by the options in the DF `RoadSignCodes`.

   EXAMPLE 1 One General IVI Container Part is used for exactly one main traffic sign. The road sign code of the main sign is listed as the first entry in the component `roadSignCodes`. Additional supplementary panels for which a road sign code is available can be listed thereafter. The sending ITS-S can include the component `preStoredLayoutId` to connect the content of the container to a pre-stored layout template defined by the service provider.

i) The GIC part can include the component `extraText`. This component can be used to present additional text associated to a sign, such as the text displayed on a supplementary panel, for which no road sign code is available in the selected catalogue.

   EXAMPLE 2 `extraText` contains one line of text per road sign code (main sign or supplementary panel) included in the component `roadSignCodes`. If present, this component is filled with as many entries as there are in the component `roadSignCodes`. If a road sign does not have extra text associated, a string with a single NULL character (ASCII 0x00) is used.

Alternatively, the component `extraText` can be used to repeat the same text associated to the main sign in different languages with the appropriate language code.

6.3.3 Road Configuration Container

6.3.3.1 Definition

The purpose of the Road Configuration Container is to convey information regarding the actual or planned configuration of a road segment. This information can be used by the receiving ITS-S for localization and/or navigation purposes.

The data elements in the Road Configuration Container are described in Table 5. The syntax is then defined in Annex A as the data type `RoadConfigurationContainer`.

Table 5 — Road Configuration Container

Container parts	Component	M/O[a]	Description
Road Configuration Container part (*n* parts)	`relevanceZoneIds`	M	List of identifier(s) of the definition(s) of the relevance zones to which the Container part applies, using the DF `ZoneIds`. If it contains only one instance of value 32, the identifiers of the zones are given in the component `laneConfiguration`.
	`roadType`	M	Type of road in the zone, see DE `RoadType` imported from ETSI/TS 102 894-2.
	`laneConfiguration`	M	List of information records about single lanes composing the relevance zone(s), using the DF `LaneConfiguration`.
[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.			

6.3.3.2 Usage

The IVI structure can contain information associated with the road configuration of a road segment in a Road Configuration Container. The IVI structure can contain information associated with adjacent road segments (e.g. subsegments of a larger road segment) in various parts of the same Road Configuration Container.

The RCC part shall include the identifier(s) of the applicable relevance zone(s) describing a road segment in the component `relevanceZoneIds` or alternatively include the identifier(s) of the applicable zone(s) describing a single lane in the data frame `LaneInformation`.

NOTE The term "relevance zone" in the context of this clause means a zone to which the Road Configuration Container part is applicable. It does not mean that the zone is necessarily a relevance zone for another Application Container. A Road Configuration Container part can be used to describe any zone, regardless of how the zone is used in other Application Containers.

The RCC part shall include a list of data frames `LaneInformation` corresponding to the lanes composing the road segment in the component `laneConfiguration` in the following way: the data frame `LaneInformation` can be repeated as often as needed to describe all lanes present; the data frame `LaneInformation` can be repeated more times for the same lane in order to convey information regarding physically distinct parts of the lane which feature different attributes, or regarding logically distinct, but physically overlapping lanes that for example feature different validity periods.

EXAMPLE 1 A single lane in a road segment subject to roadworks merges with another lane at the start of the roadworks zone and opens again as a separate lane at the end of the roadworks zone. The lane is represented by two instances of `LaneInformation`, one merging with the second lane, the second one starting as an open lane again.

EXAMPLE 2 A single lane in a road segment subject to roadworks has different lane delimitations with corresponding zones defined in the Location Container. The lane is represented by three instances of `LaneInformation`, the first one with no delimitation left and right, the second type with delimitation of type "wall" left and right, the third one with no delimitation left and right.

EXAMPLE 3 An emergency lane can be opened to traffic during peak hours, hence that same physical lane has two logical representations which are time-dependent.

6.3.4 Text Container

6.3.4.1 Definition

The purpose for Text Container is to allow the presentation of additional information for usage in the in-vehicle signage use case or of information which is not IVS related. This information is in the form of text or an image file. For descriptions of these use-cases, see Reference [11].

The data elements in the Text Container are described in Table 6. The syntax is then defined in Annex A as the data type `TextContainer`.

Table 6 — Text Container

Container parts	Component	M/O[a]	Description
Text Container part (*n* parts)	`detectionZoneIds`	O	List of identifier(s) of the definition(s) of the detection zones, using the DF `ZoneIds`.
	`relevanceZoneIds`	M	List of identifier(s) of the definition(s) of the relevance zone(s), to which the Text Container applies, using the DF `ZoneIds`.
	`direction`	O	Direction of relevance within the relevance zone using the DE `Direction` as imported from ETSI/TS 102 894-2.
	`driverAwarenessZoneIds`	O	List of identifier(s) of the definition(s) of the driver awareness zone(s), using the DF `ZoneIds`.
	`minimumAwarenessTime`	O	Time in tenths of seconds before the vehicle enters the relevance zone, in which the IVI should be available as a minimum.
	`applicableLanes`	O	List of identifier(s) for the lane(s) to which the Text Container applies, using the DF `LanePositions`.
	`layoutId`	O	Identifier of the connected layout definition in the IVI structure.
	`preStoredLayoutId`	O	Identifier of a pre-stored layout definition.
	`text`	O	List of language codes and text in the selected language, using the DF `TextLines`.
	`data`	M	Data binary large object (BLOB) of a defined type (file).
Extension to the Text Container Part	`iviType`	M	Priority of the Container information within the overall context of IVI. See DE `IviType`.
	`laneStatus`	O	Status of the lane(s) to which the Container part applies. See DE `LaneStatus`.
	`vehicleCharacteristics`	O	Vehicle characteristics for which the IVI is applicable. See DF `VehicleCharacteristicsList`.

[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.

6.3.4.2 Usage

The IVI structure can contain text information or data associated with dynamic road signs in one or more Text Container parts. All parts that semantically belong together should be included in the same Container (e.g. all parts belonging to the same sign). The following provisions apply to each Text Container part.

a) The TC part can include the identifier(s) for detection zone(s) in the component `detectionZoneIds`.

b) The TC part shall, at minimum, include one identifier of the applicable relevance zone in the component `relevanceZoneIds`.

c) The TC part can include the component `direction` to describe the direction of relevance within a relevance zone representing a road segment, with respect to the direction associated to the segment.

In case the component `direction` is present, all relevance zones of type segment listed inside the component `relevanceZoneIds` shall have the same implicit direction.

d) For driver awareness purposes, the TC part can include either the identifier(s) of recommended driver awareness zone(s) in the component `driverAwarenessZoneIds` or the recommended minimum awareness time in the component `minimumAwarenessTime`, or none of those.

e) The TC part can include the component `applicableLanes` to describe independently from information in the Location Container the lane(s) to where the Text Container applies. This serves as a basis to correlate the information to a lane even if the location information does not support lane identification. If the information applies transversally to the entire relevance zone (all lanes), the component shall be absent.

f) The TC part can include either the component `layoutId` to connect the content of the Container to a definition of the layout as defined in the Layout Container in the IVI structure or the component `preStoredLayoutId` to connect the content of the Container to a pre-stored layout template.

g) The TC part can include the component `text`. The sending ITS-S can repeat the same text in the component `text` in different languages with the appropriate language code. The TC Part shall include data of any predefined type in the component `data`. If there is no data to include, the component `data` shall be present without data, i.e. only containing a length indicator indicating length 0.

In case the Container's extension is used, the following applies.

1) The TC part shall include the component `iviType` to provide a means to triage the IVI information based on degree of criticality.

2) The TC part can include the optional components `laneStatus` and `vehicleCharacteristics`. The component `laneStatus` describes special properties of the relevant lane(s) and can be used as an alternative to the Road Configuration Container. The component `vehicleCharacteristics` indicates for which vehicles the information is applicable and can be used by the receiving ITS-S to filter out non-applicable Application Container parts.

6.3.5 Layout Container

6.3.5.1 Definition

The purpose for the Layout Container is to convey information about the suggested graphical layout of the information provided by General IVI Container(s) or Text Container(s) or both being displayed to the driver. This can be used, for example, to present the information in the vehicle with a similar arrangement as is presented on the road, i.e. by reflecting the real layout of the variable message sign on the road or in other more appropriate ways.

The data elements in the Layout Container are described in Table 7. The syntax is then defined in Annex A as the data type `LayoutContainer`.

Table 7 — Layout Container

Container Parts	Component	M/O[a]	Description
Layout Container Part (*n* parts)	`layoutId`	M	Identifier of the layout definition inside the IVI structure.
	`height`	O	Height of the layout grid in number of grid points along the y direction.
	`width`	O	Width of the layout of the grid in number of grid points along the x direction.
	`layoutComponents`	M	List of definitions of the components on the grid using the DF `LayoutComponents`.

[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.

6.3.5.2 Usage

The IVI structure can contain layout information associated to General IVI Container(s) and or Text Container(s) in one or more Layout Container parts. Each part shall specify one single layout. The following provisions apply to each General Layout Container part.

a) The layout is defined as a two-dimensional grid of coordinates with a size defined by the number of grid points along the x and y directions. The centre of the reference system is in the lower left corner of the grid with the x coordinate horizontally and the y coordinates vertically. Components are rectangles defined by their width and height and the position of their lower left corner on the grid.

b) The LC Part shall include for each layout the components `layoutId` and `layoutComponents`. The components `height` and `width` are optional and describe the dimensions of the layout. They can also be implicitly deduced from the sum of the components on the layout. The LC part shall include all definitions of components of a layout in the component `layoutComponents`.

6.3.6 Automated Vehicle Container

6.3.6.1 Definition

The purpose for the Automated Vehicle Container is to contain information associated with real or virtual road signs which is specific for automated vehicles to support use cases like cooperative adaptive cruise control or platooning. For descriptions of these use-cases, see Reference [11] and [12].

The data elements in the Automated Vehicle Container are described in Table 8. The syntax is then defined in Annex A as the data type `AutomatedVehicleContainer`.

Table 8 — Automated Vehicle Container

Container parts	Component	M/O[a]	Description
Automated Vehicle Container part (*n* parts)	`detectionZoneIds`	O	List of identifier(s) of the definition(s) of the detection zone(s), using the DF `ZoneIds`.
	`relevanceZoneIds`	M	List of identifier(s) of the definition(s) of the relevance zone(s), to which the Container applies, using the DF `ZoneIds`.
	`direction`	O	Direction of relevance within the relevance zone using the DE `Direction` as imported from ETSI/TS 102 894-2.
	`applicableLanes`	O	List of identifiers of the lane(s) to which the Container applies using the DF `LanePositions`.
	`vehicleCharacteristics`	O	Vehicle characteristics, for which the Container is applicable using the DF `VehicleCharacteristicsList`.
	`automatedVehicleRules`	O.1[b]	A list of rules applying to automated vehicles using the DF `AutomatedVehicleRules`.
	`platooningRules`	O.1	A list of rules applying to automated vehicles in a platoon using the DF `PlatooningRules`.

[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.

[b] Conditional Optional (O.1) shall be included in the Container if the other element O.1 is absent and may be included if the other element O.1 is present.

6.3.6.2 Usage

The IVI structure can contain the information associated with automated vehicles in one or more Automated Vehicle Container parts. All parts that semantically belong together should be included in the same container (e.g. all parts belonging to the same situation). The following provisions apply to each Automated Vehicle Container part.

a) The AVC part can include the identifier(s) for detection zone(s) in the component `detectionZoneIds`.

b) The AVC part shall, at minimum, include one identifier of a relevance zone in the component `relevanceZoneIds`.

c) The AVC part can include the component `direction` to describe the direction of relevance within a relevance zone representing a road segment, with respect to the direction associated to the segment. In case the component `direction` is present, all relevance zones of type segment listed inside the component `relevanceZoneIds` shall have the same implicit direction.

d) The AVC part can include the component `applicableLanes` to describe independently from information in the Location Container the lane(s) to which the information applies. This serves as a basis for correlating the information to a lane even if the location information does not support lane identification. If the information applies transversally to the entire relevance zone (all lanes), the component shall be absent.

e) The AVC part can include the component `vehicleCharacteristics` to indicate for which types of vehicles the information is applicable. This information can be used by the receiving ITS-S to filter out non-applicable Automated Vehicle Container parts.

f) The AVC part shall include either one or both of the components `automatedvehicleRules` or `platooningRules` to specify applicable rules for automated vehicles. This information is intended for processing and application by the receiving ITS-S in the automated vehicle, as well as optionally for presentation to the driver.

6.3.7 Road Surface Container

6.3.7.1 Definition

The purpose for the Road Surface Container is to convey information regarding condition of the road surface i.e. the pavement. This information can be used by the receiving ITS-S for driving automation purposes.

The data elements in the Road Surface Container are described in Table 9. The syntax is then defined in Annex A as the data type `RoadSurfaceContainer`.

Table 9 — Road Surface Container

Container parts	Component	M/O[a]	Description
Road Surface Container part (*n* parts)	`detectionZoneIds`	O	List of identifier(s) of the definition(s) of the detection zone(s), using the DF `ZoneIds`.
	`relevanceZoneIds`	M	List of identifier(s) of the definition(s) of the relevance zone(s), to which the Container applies, using the DF `ZoneIds`.
	`direction`	O	Direction of relevance within the relevance zone using the DE `Direction` as imported from ETSI/TS 102 894-2.
	`roadSurfaceStaticCharacteristics`	0.1[b]	Static characteristics of the road surface of the road segment using the DF `RoadSurfaceStaticCharacteristics`.
	`roadSurfaceDynamicCharacteristics`	0.1	Dynamic characteristics of the road surface of the road segment using the DF `RoadSurfaceDynamicCharacteristics`.

[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.

[b] Conditional Optional (0.1) shall be included in the Container if the other element 0.1 is absent and may be included if the other element 0.1 is present.

6.3.7.2 Usage

The IVI structure can contain information associated with the road surface of a road segment in one Road Surface Container part. The sending ITS-S can include information associated with adjacent road segments

(e.g. subsegments of a larger road segment) in various parts of the same Road Configuration Container. The following requirements apply to each Road Configuration Container part.

a) The RSC part can include the identifier(s) for detection zone(s) in the component `detectionZoneIds`.

b) The RSC part shall, at minimum, include one identifier of a relevance zone in the component `relevanceZoneIds`.

c) The RSC part can include the component `direction` to describe the direction of relevance within a relevance zone representing a road segment, with respect to the direction associated to the segment. In case the component `direction` is present, all relevance zones of type segment listed inside the component `relevanceZoneIds` shall have the same implicit direction.

d) The RSC part shall include either one or both of the components `roadSurfaceStaticCharacteristics` or `roadSurfaceDynamicCharacteristics` for the road segment to which the Container part applies. This information is intended for processing and application by the receiving ITS-S in the automated vehicle, as well as optionally for presentation to the driver.

6.3.8 Infrastructure Support Container

6.3.8.1 Definition

The purpose for the Infrastructure Support Container is to convey information regarding physical or digital infrastructure support (or both) for automated driving systems (see for example Reference [17]). This information can be conveyed by the receiving ITS-S in the vehicle to an automated driving system for the management of driving automation functions.

The data elements in the Infrastructure Support Container are described in Table 10. The syntax is then defined in Annex A as the data type `InfrastructureSupportContainer`.

Table 10 — Infrastructure Support Container

Container parts	Component	M/O[a]	Description
Infra-structure Support Container part (*n* parts)	`detectionZoneIds`	O	List of identifier(s) of the definition(s) of the detection zone(s), using the DF `ZoneIds`.
	`relevanceZoneIds`	M	List of identifier(s) of the definition(s) of the relevance zone(s), to which the Container applies, using the DF `ZoneIds`.
	`direction`	O	Direction of relevance within the relevance zone using the DE `Direction` as imported from ETSI/TS 102 894-2.
	`infrastructureSupport`	M	Information about infrastructure support using the DF `InfrastructureSupportInformation`.
[a] Mandatory (M) shall be included in the Container. Optional (O) may be included in the Container.			

6.3.8.2 Usage

The IVI structure can define information about infrastructure support on a road segment in one Infrastructure Support Container part. The sending ITS-S can include information associated with adjacent road segments (e.g. subsegments of a larger road segment) in various parts of the same Infrastructure Support Container. The following requirements apply to each Infrastructure Support Container part.

a) The ISC part can include the identifier(s) for detection zone(s) in the component `detectionZoneIds`.

b) The ISC part shall, at minimum, include one identifier of a relevance zone in the component `relevanceZoneIds`.

c) The ISC part can include the component `direction` to describe the direction of relevance within a relevance zone representing a road segment, with respect to the direction associated to the segment. In case the component `direction` is present, all relevance zones of type segment listed inside the component `relevanceZoneIds` shall have the same implicit direction.

d) The ISC part shall include the component `infrastructureSupport` for the road segment to which the Container part applies. The information objects contained in this component shall correspond to support items that are or may be provided, if applicable, in the indicated relevance zone(s), and are intended for processing and application by an automated driving system in the vehicle.

EXAMPLE 1 The road pavement features horizontal lane markings according to a defined standard and/or with a specified width and reflectivity. A corresponding information object is included providing information about the availability of these markings and their characteristics.

EXAMPLE 2 Digital information about road traffic events is provided over a specified interface according to defined standards, whenever applicable. A corresponding information object is included that provides information about the potential provision of that information.

7 Description of data frames and data elements

7.1 General

The following clauses contain the definition of the semantics of data frames and data elements used by the IVI Containers in alphabetical order. The syntax is then defined in Annex A.

Data frames and data elements are either defined in this document or imported by reference from other standards.

7.2 Data frames

7.2.1 AbsolutePosition

The data frame `AbsolutePosition` provides the information regarding an absolute position comprising the following:

— in its component `latitude`, the latitude as coded by the data element `Latitude` imported from ETSI/TS 102 894-2;

— in its component `longitude`, the longitude as coded by the data element `Longitude` imported from ETSI/TS 102 894-2.

7.2.2 AbsolutePositionWAltitude

The data frame `AbsolutePositionWAltitude` provides the information regarding an absolute position comprising the following:

— in its component `latitude`, the latitude as coded by the data element `Latitude` imported from ETSI/TS 102 894-2;

— in its component `longitude`, the longitude as coded by the data element `Longitude` imported from ETSI/TS 102 894-2;

— in its component `altitude`, the altitude as coded by the data frame `Altitude` imported from ETSI/TS 102 894-2.

7.2.3 AnyCatalogue

The data frame `AnyCatalogue` shall indicate the road sign code according to a catalogue of road signs as agreed, for example, between the roles "service provision" and "presentation provision" (see ISO 17427-1):

— the component `owner` shall indicate the owner of the catalogue as coded by the data element `Provider`;

— the component `version` shall indicate the version of the catalogue;

— the component `pictogramCode` shall indicate the code of the pictogram representing the road sign;

— the component `value`, if present, shall indicate a value associated to the sign;

— the component `unit`, if present, shall indicate the unit associated to the sign;

— the component `attributes`, if present, shall indicate additional attributes associated to the sign as coded by the data frame `ISO14823Attributes`.

7.2.4 AutomatedVehicleRule

The data frame `AutomatedVehicleRule` shall contain a consistent set of rules applicable to automated vehicles as follows:

— the component `priority` shall indicate the level of priority of the information as coded by the data element `Priority`;

— the component `allowedSaeAutomationLevels` shall indicate the allowed vehicle automation levels as coded by the data frame `SaeAutomationLevels`;

— the component `minGapBetweenVehicles`, if present, shall indicate the minimum allowed distance between an automated vehicle and the preceding vehicle, as coded by the data element `MinGapBetweenVehicles`;

— the component `recGapBetweenVehicles`, if present, shall indicate the recommended allowed distance between an automated vehicle and the preceding vehicle, as coded by the data element `RecGapBetweenVehicles`;

— the component `automatedVehicleMaxSpeedLimit`, if present, shall indicate the maximum speed limit applicable to all automated vehicles of the listed types, as coded by the data element `SpeedValue` imported from ETSI/TS 102 894-2;

— the component `automatedVehicleMinSpeedLimit`, if present, shall indicate the minimum speed limit applicable to all automated vehicles of the listed types, as coded by the data element `SpeedValue` imported from ETSI/TS 102 894-2;

— the component `automatedVehicleSpeedRecommendation`, if present, shall indicate the recommended speed applicable to all automated vehicles of the listed types, as coded by the data element `SpeedValue` imported from ETSI/TS 102 894-2;

— the component `roadSignCodes`, if present, shall indicate a list of road sign codes applicable to all automated vehicles of the listed types, as coded by the data frame `RoadSignCodes`;

— the component `extraText`, if present, shall indicate lines of text associated to the ordered list of road sign codes, as coded by the data frame `ConstraintTextLines2`.

NOTE The rules coded in a data frame `AutomatedVehicleRule` are considered connected by the logical AND operator. The rule sets coded in a data frame `AutomatedVehicleRules` are considered connected by the logical OR operator.

EXAMPLE `AutomatedVehicleRule 1` defines that automated vehicles operating at level 3 and level 4 can operate with minimum 50 m gap, at maximum 60 km/h. `AutomatedVehicleRule 2` defines that automated vehicles operating at level 3 can operate with minimum 80 m gap, at maximum 80 km/h. Therefore, an automated vehicle operating at level 3 can decide whether to conform to all rules in `AutomatedVehicleRule 1` or in `AutomatedVehicleRule 2`.

7.2.5 CompleteVehicleCharacteristics

The data frame `CompleteVehicleCharacteristics` shall contain the definition of the characteristics of the vehicles to which an Application Container is applicable. It can be used by the receiving ITS-S to filter out non-applicable Containers. It is defined as follows:

— the component `tractor`, if present, shall contain the characteristics applicable to the (motorized) pulling vehicle, as coded by the data frame `TractorCharacteristics`;

— the component `trailer`, if present, shall contain the characteristics applicable to one or more trailers, as coded by the data frame `TrailerCharacteristics`;

— the component `train`, if present, shall contain the characteristics applicable to the entire vehicle train, as coded by the data frame `TrainCharacteristics`.

7.2.6 ComputedSegment

The data frame `ComputedSegment` shall contain the definition of a road segment as computed from another, already defined, adjacent road segment where:

— the component `zoneId` shall indicate the identifier of the segment from which this segment is computed, as coded by the data element `Zid`;

— the component `laneNumber` shall indicate the lane number of the segment from which this segment is computed, as coded by the data element `LanePosition` imported from ETSI/TS 102 894-2;

— the component `laneWidth` shall indicate the width of the computed segment, as coded by the data element `LaneWidth` imported from ETSI/TS 102 894-2;

— the component `offsetDistance`, as a first option, shall indicate the perpendicular offset from the reference lane from which the computed lane is offset, in units of 1 cm;

— the component `offsetPosition`, as a second option, shall indicate the reference position in relation to the reference position of the lane which has been taken as a reference, as coded by the data frame `deltaReferencePosition` imported from ETSI/TS 102 894-2.

7.2.7 DeltaPosition

The data frame `DeltaPosition` provides information regarding a relative position comprising the following:

— in its component `deltaLatitude`, the delta latitude with respect to the reference position, as coded by the data element `DeltaLatitude` imported from ETSI/TS 102 894-2;

— in its component `deltaLongitude`, the delta longitude with respect to the reference position, as coded by the data element `DeltaLongitude` imported from ETSI/TS 102 894-2.

7.2.8 InfrastructureSupportInformation

The data frame `InfrastructureSupportInformation` provides information about infrastructure support, comprising the following:

— in its component `baseOid`, the Object Identifier of the ASN.1 module that specifies the identifiers of the infrastructure support items and the data types that shall be used to specify their information (see Annex A for details);

— in its component `supportList`, the list of support items together with their associated information, according to the specification referenced in the component `baseOid`, as coded by the data frame `SupportItems`.

7.2.9 ISO14823Attribute

The data frame `ISO14823Attribute` provides a choice of attributes according to ISO 14823-1:

— the alternative `dtm` of type `InternationalSign-applicablePeriod`,

— the alternative `edt` of type `InternationalSign-exemptedApplicablePeriod`,

— the alternative `dfl` of type `InternationalSign-directionalFlowOfLane`,

— the alternative `ved` of type `InternationalSign-applicableVehicleDimensions`,

— the alternative `spe` of type `InternationalSign-speedLimits`,

— the alternative `roi` of type `InternationalSign-rateOfIncline`,

— the alternative `dbv` of type `InternationalSign-distanceBetweenVehicles`,

— the alternative `ddd` of type `InternationalSign-destinationInformation`.

7.2.10 ISO14823Code

The data frame `Iso14823Code` shall indicate the road sign code according to ISO 14823-1 as follows:

— the component `pictogramCode` shall contain the pictogram code subdivided into country code, service category code and pictogram code as defined in ISO 14823-1;

— the component `attributes` shall contain the applicable attributes as defined in ISO 14823-1 and as coded by the data frame `ISO14823Attributes`.

7.2.11 LaneInformation

The data frame `LaneInformation` shall provide information about a single lane of a road segment as follows:

— the component `laneNumber` shall contain the identifier of the lane to which the information applies, as coded by the data frame `LanePosition` imported from ETSI/TS 102 894-2;

— the component `direction` shall contain the direction of the road segment to which the lane belongs, as coded by the data element `Direction` imported from ETSI/TS 102 894-2;

— the component `validity`, if present, shall contain the validity period of the information contained in the data frame, as coded by the data element `InternationalSign-applicablePeriod` imported from ISO 14823-1;

— the component `laneType` shall contain the type of lane during the indicated validity period, as coded by the data element `LaneType` imported from ETSI/TS 102 894-2;

— the component `laneTypeQualifier`, if present, shall contain information qualifying the lane to be dedicated to vehicles with defined characteristics, as coded by the data element `CompleteVehicleCharacteristics`;

— the component `laneStatus` shall contain the status of the lane during the indicated validity period, as coded by the data element `LaneStatus`;

— the component `laneWidth`, if present, shall contain the width of the lane, as coded by the data element `LaneWidth` imported from ETSI/TS 102 894-2.

EXAMPLE The component `laneTypeQualifier` can be present to qualify lane types 7 `dedicatedVehicle`, 8 `bus`, 9 `taxi`, 10 `hov` and 11 `hot`.

The extension of the data frame `LaneInformation`, if present, shall provide information about a single lane of a road segment as follows:

— the component `detectionZoneIds`, if present, shall indicate the identifier(s) of the detection zone(s) that leads to the relevance zone as coded by the data frame `ZoneIds`;

— the component `relevanceZoneIds`, if present, shall indicate the identifier(s) of the relevance zone(s) that represent the lane to which the information applies as coded by the data frame `ZoneIds`;

— the component `LaneCharacteristics`, if present, shall indicate the characteristics of the lane as coded by the data frame `LaneCharacteristics`;

— the component `laneSurfaceStaticCharacteristics`, if present, shall indicate the static characteristics of the road surface of the lane as coded by the data frame `roadSurfaceStaticCharacteristics`, and overrides the information present in the Road Surface Container for that lane;

— the component `LaneSurfaceDynamicCharacteristics`, if present, shall indicate the static characteristics of the road surface of the lane as coded by the data frame `roadSurfaceDynamicCharacteristics` and overrides the information present in the Road Surface Container for that lane.

7.2.12 LaneCharacteristics

The data frame `LaneCharacteristics` shall provide information about the physical characteristics of a lane as follows:

— the component `zoneDefinitionAccuracy` shall indicate the accuracy of the zone's geographic information given in the Location Container as coded by the data element `DefinitionAccuracy`;

— the component `existinglaneMarkingStatus` shall indicate the status of the existing lane markings as coded by the data element `LaneMarkingStatus`;

— the component `newlaneMarkingColour` shall indicate the colour of the new markings as coded by the data element `MarkingColour`;

— the component `laneDelimitationLeft` shall indicate the type of lane delimitation on the left side of the lane in direction of traffic, as coded by the data element `laneDelimitation`;

— the component `laneDelimitationRight` shall indicate the type of lane delimitation on the right side of the lane in direction of traffic, as coded by the data element `laneDelimitation`;

— the component `mergingWith` shall indicate, for lanes with `laneStatus`: `mergeR`, `mergeL`, `mergeLR`, or `diverging`, the ID of the zone with which the lane is merging or from which the lane is diverging, as coded by the data element `Zid`. For all other values of `laneStatus`, `Zid` shall have the value 32.

7.2.13 LayoutComponent

The data frame `LayoutComponent` shall specify a single component of a layout according to the following terms:

— the component `id` within the layout;

— the `height` of the component in number of grid points;

— the `width` of the component in number of grid points;

— the `x` position of its lower left corner;

— the `y` position of its lower left corner;

— the `scripting` direction of the text in the component (if applicable).

7.2.14 LoadType

The data frame `loadType` shall contain information about the vehicle's load as follows:

— the component `goodsType` shall contain information about the goods being transported as coded by the data element `GoodsType`;

— the component `dangerousGoodsType`, if present, shall contain the type of dangerous goods according to the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)[19] as coded by the data element `DangerousGoodsBasic` imported from ETSI/TS 102 894-2;

— the component `specialTransportType`, if present, shall contain the type of special transport according to local regulations as coded by the data element `SpecialTransportType` imported from ETSI/TS 102 894-2.

7.2.15 MapReference

In this edition of this document, the data frame `MapReference` is imported from ETSI/TS 102 894-2 in a backwards compatible manner.

7.2.16 PlatooningRule

The data frame `PlatooningRule` shall contain a consistent set of rules applicable to vehicles forming a platoon as follows:

— the component `priority` shall indicate the level of priority of the information as coded by the data element `PriorityLevel`;

— the component `allowedSaeAutomationLevels` shall indicate the vehicle automation levels that are allowed to be operated by platoon followers, as coded by the data frame `SaeAutomationLevels`;

— the component `maxNoOfVehicles`, if present, shall indicate the maximum number of vehicles allowed to be part of a platoon, as coded by the data element `MaxNoOfVehicles`;

— the component `maxLenghtOfPlatoon`, if present, shall indicate the maximum length of the platoon, as coded by the data element `MaxLenghtOfPlatoon`;

— the component `minGapBetweenVehicles`, if present, shall indicate the minimum allowed distance between automated vehicles in the platoon, as coded by the data element `MinGapBetweenVehicles`;

— the component `platoonMaxSpeedLimit`, if present, shall indicate the maximum speed limit applicable to all automated vehicles in the platoon, as coded by the data element `SpeedValue` imported from ETSI/TS 102 894-2;

— the component `platoonMinSpeedLimit`, if present, shall indicate the minimum speed limit applicable to all automated vehicles in the platoon, as coded by the data element `SpeedValue` imported from ETSI/TS 102 894-2;

— the component `platoonSpeedRecommendation`, if present, shall indicate the recommended speed applicable to all automated vehicles in the platoon, as coded by the data element `SpeedValue` imported from ETSI/TS 102 894-2;

— the component `roadSignCodes`, if present, shall indicate a list of road sign codes applicable to all automated vehicles in the platoon, as coded by the data frame `RoadSignCodes`;

— the component `extraText`, if present, shall indicate lines of text associated with the ordered list of road sign codes, as coded by the data frame `ConstraintTextLines2`.

The extension of the data frame `PlatooningRule`, if present, shall provide a consistent set of rules applicable to automated vehicles as follows:

— the component `inLanelateralDisplacement`, if present, shall indicate the recommended lateral displacement of the vehicle's reference position from the middle of the lane in cm: negative values indicate displacement to the left; positive values indicate displacement to the right.

NOTE The of rules coded in a data frame `PlatooningRule` are considered connected by the logical AND operator. The rule sets coded in a data frame `PlatooningRules` are considered connected by the logical OR operator.

EXAMPLE `PlatooningRule 1` defines that platoon followers operating at levels 2, 3 and 4 can operate in a platoon of maximum length 10 vehicles, with minimum 50 m gap, at maximum 60 km/h. `PlatooningRule 2` defines that platoon followers operating at level 2 can operate in a platoon of maximum length 3 vehicles, with minimum 5 m gap, at maximum 80 km/h. Therefore, a platoon of 3 vehicles operating at level 2 can decide whether to conform to all rules in `PlatooningRule 1` or `PlatooningRule 2`.

7.2.17 PolygonalLine

The data frame `PolygonalLine` shall contain the definition of a polygonal line (also known as polygonal chain) as one of the following alternatives:

— an ordered sequence of delta positions with respect to the previous position, with latitude and longitude, as coded by the data frame `DeltaPositions`, with the first instance referring to a reference position and with the order implicitly defining a direction associated with the polygonal line;

— an ordered sequence of delta positions with respect to the previous position, with latitude, longitude, and altitude, as coded by the data frame `DeltaReferencePositions`, with the first instance referring to a reference position and with the order implicitly defining a direction associated with the polygonal line;

— a sequence of absolute positions, with latitude and longitude, as coded by the data frame `AbsolutePositions`;

— a sequence of absolute positions, with latitude, longitude and altitude, as coded by the data frame `AbsolutePositionWAltitudes`.

NOTE In this document, the reference position of the GLC is not included in the definition of polygonal line.

7.2.18 RoadSurfaceDynamicCharacteristics

The data frame `RoadSurfaceDynamicCharacteristics` shall contain the dynamic characteristics of the road surface as follows:

— the component `condition` shall indicate the predominant condition of the road surface as coded by the data element `Condition`;

— the component `temperature` shall indicate the average temperature of the road surface as coded by the data frame `Temperature`;

— the component `iceOrWaterDepth` shall indicate the average thickness of ice or depth of water on the road surface as coded by the data frame `Depth`;

— the component `treatment` shall indicate the treatment that has been applied to the road surface as coded by the data element `Treatment`.

7.2.19 RoadSurfaceStaticCharacteristics

The data frame `RoadSurfaceStaticCharacteristics` shall contain the static characteristics of the road surface as follows:

— the component `frictionCoefficient` shall indicate the average coefficient of friction featured by the road surface as coded by the data element `FrictionCoefficient`;

— the component `materialType` shall indicate the type of material that builds the road surface, as coded by the data element `MaterialType`;

— the component `wear` shall indicate the wear level of the road surface as coded by the data element `WearLevel`;

— the component `avBankingAngle` shall indicate the average banking angle of the road surface as coded by the data element `BankingAngle`.

7.2.20 RSCode

The content of the data frame `RSCode` can be associated to a layout component of Referenced Layout using the component `layoutComponentId`.

The data frame `RSCode` shall contain the definition of the road sign code. It allows different options pointing to different pictogram catalogues:

— the alternative `viennaConvention` shall indicate the road sign code according to the Vienna Convention, as coded by the data frame `VcCode`;

— the alternative `iso14823` shall indicate the road sign coded according to ISO 14823-1, as coded by the data frame `Iso14823Code`;

— the alternative `itisCodes` shall indicate the road sign code according to SAE J2540/2;

— the alternative `anyCatalogue` shall indicate the road sign code as coded by the data frame `AnyCatalogue`.

7.2.21 Segment

The data frame `Segment` shall contain the definition of a road segment where:

— the component `line` shall contain the definition of the segment as an open polygonal chain, as coded by the data frame `PolygonalLine`. The reference position of this component shall be the reference position specified in the common Location Container content of the Geographic Location Container in which the zone is defined. The open polygonal line shall be located:

  — at the transversal middle of the set of all regular driving lanes of the carriageway, if the definition of the segment applies to the entire carriageway, or

  — at the transversal middle of the set of all regular driving lanes of one traffic direction of the carriageway, if the definition of the segment applies to all lanes of one traffic direction, or

  — at the transversal middle of the lane, if the definition of the segment applies to the lane;

— the component `laneWidth` shall only be used if the definition of the segment applies to the lane, and if present, shall indicate the width of the lane as coded by the data element `LaneWidth` imported from ETSI/TS 102 894-2. The absence of the component `laneWidth` shall indicate that the width of the segment corresponds to the driveable lanes of the segment.

The direction associated to data frame `Segment` shall be the direction of the component `line`.

7.2.22 SegmentExtended

The data frame `SegmentExtended` shall contain the definition of a road segment where:

— the component `segmentReferencePosition`, if present, shall contain the identifier of the zone, of which the last position is the reference position for the component `line`, as coded by the data element `Zid`; if this component is absent, the reference position of the component `line` shall be the reference position specified in the common Location Container content of the Geographic Location Container in which the zone is defined;

— the component `line` shall contain the definition of the segment as an open polygonal line located at a defined transversal position of a set of regular driving lanes of one traffic direction of the carriageway, as coded by the data frame `PolygonalLine`;

— the component `segmentWidthLeft`, if present, shall indicate the width of the road segment left of the polygonal line in the direction associated to the component `line`, as coded by the data element `StandardLength9b` imported from ETSI/TS 102 894-2. The absence of the component `segmentWidthLeft` shall indicate that the width of the segment corresponds to all driveable lanes of the segment;

— the component segmentWidthRight may be present only if the component segmentWidthLeft is present, and in that case shall indicate the width of the road segment right of the polygonal line in direction of the zone, as coded by the data element StandardLength9b imported from ETSI/TS 102 894-2. The absence of the component segmentWidthRight while the component segmentWidthLeft is present shall indicate that the width of the segment right of the polygonal line is equal to the width left of the polygonal line.

The direction associated to the data frame SegmentExtended shall be the direction of the component line.

7.2.23 SupportItem

The data frame SupportItem shall be defined as an information object of the class InformationContainer and shall be listed in the information object set InfrastructureSupportSet. It shall contain the following:

— in its component id, the identifier of the support item within the set;

— in its component content, the information about the provided support item identified by the component id, using the data type associated to the information object in the information object set.

EXAMPLE 1 The information object with Id=1 informs about the width and reflectivity of road markings using a SEQUENCE type with two INTEGER components: width and reflectivity.

EXAMPLE 2 The information object with Id=2 informs about the provided road event data using a SEQUENCE type with a SEQUENCE OF component named eventTypes that lists the event types about which information is provided, and an ENUMERATED component named dataModel, listing the standards that describe the data model used to specify the data.

A template for defining the InfrastructureSupportSet is specified in Annex A.

7.2.24 Text

The data frame Text shall contain the following:

— in its component language the ISO 639 Set 1 2-letter language code with Telegraph Alphabet No. 2 encoding;

— in its component textContent the text itself.

The text content of the data frame text can be associated to a layout component of the referenced layout as coded by the component layoutComponentId.

7.2.25 TractorCharacteristics

The data frame TractorCharacteristics shall contain the definition of characteristics applicable to pulling vehicles, as the logical AND operator of the single characteristics defined in the following components:

— the component equalTo shall contain the definition of a series of applicable discrete vehicle characteristics, as coded by the data frame VehicleCharacteristicsFixValues;

— the component notEqualTo shall contain the definition of a series of not applicable discrete vehicle characteristics, as coded by the data frame VehicleCharacteristicsFixValues;

— the component ranges shall contain the definition of a series of applicable ranges of continuous vehicle characteristics, as coded by the data frame VehicleCharacteristicsRanges.

7.2.26 TrailerCharacteristics

The data frame TrailerCharacteristics shall contain the definition of characteristics applicable to trailed vehicles as the logical AND operator of the single characteristics defined in the following components:

— the component equalTo shall contain the definition of a series of applicable discrete vehicle characteristics, as coded by the data frame VehicleCharacteristicsFixValues;

— the component `notEqualTo` shall contain the definition of a series of not applicable discrete vehicle characteristics, as coded by the data frame `VehicleCharacteristicsFixValues`;

— the component `ranges` shall contain the definition of a series of applicable ranges of continuous vehicle characteristics, as coded by the data frame `VehicleCharacteristicsRanges`.

7.2.27 TrainCharacteristics

The data frame `TrainCharacteristics` shall contain the definition of characteristics applicable to an entire vehicle train, as coded by the data frame `TractorCharacteristics`.

7.2.28 VcCode

The data frame `VcCode` shall indicate the road sign code according to the Vienna Convention as follows:

— its component `roadSignClass` shall indicate the Vienna Convention Sign Class (e.g. the "A" in A, 28 a), as coded in the data element `VcClass`;

— its component `roadSignCode` shall contain the code of the road sign (e.g. the "28" in A, 28 a);

— its component `vcOption` shall contain the option of the road sign (e.g. the "a" in A, 28 a), as coded in data element `VcOption`;

— its component `validity`, if present, shall indicate validity information associated to the sign as coded in the data frame `ValidityPeriods`;

— its component `value`, if present, shall indicate a value associated to the road sign;

— its component `unit`, if present, shall indicate the unit associated to such value (e.g. 50 km/h associated to road sign C, 14), as coded in the data element `RSCUnit`.

7.2.29 VehicleCharacteristicsFixValues

The data frame `VehicleCharacteristicsFixValues` shall contain characteristics of the vehicle to which the Application Container is applicable in discrete values. The data frame offers the following alternatives:

— the alternative `simpleVehicleType` shall contain the simple vehicle type, as coded by the data element `StationType` from ETSI/TS 102 894-2;

— the alternative `euVehicleCategoryCode` shall contain the European vehicle category code, as coded by the data element `EuVehicleCategoryCode` imported from ETSI/TS 102 894-2;

— the alternative `iso3833VehicleType` shall contain the complex vehicle type, as coded by the data element `ISO3833VehicleType` imported from ETSI/TS 102 894-2;

— the alternative `euroAndco2` shall contain the value Euro and CO_2 values, as coded by the data element `EnvironmentalCharacteristics` imported from ISO 17573-3;

— the alternative `engineCharacteristics` shall contain the engine characteristics, as coded by the data element `EngineCharacteristics` imported from ISO 17573-3;

— the alternative `loadType` shall contain information about the vehicle's load, as coded by the data element `LoadType`;

— the alternative `exhaustEmissionValues` shall contain the exhaust emission values, as coded by the data element `ExhaustEmissionValues` imported from ISO 17573-3;

— the alternative `usage` shall contain the type of claimed usage of the vehicle, as coded by the data element `VehicleRole` imported from ETSI/TS 102 894-2.

7.2.30 VehicleCharacteristicsRanges

The data frame `VehicleCharacteristicsFixValues` shall contain characteristics of the vehicle to which the Application Container is applicable in ranges of continuous values. The data frame is defined as follows:

— the component `comparisonOperator` shall indicate the logical operator to be used when comparing the limit given in the component `limits` with the actual vehicle characteristics;

— the component `limits` shall indicate the applicable limit through one of the following alternatives:

  — the alternative `numberOfAxles` shall contain information the limit of the number of axles;

  — the alternative `vehicleDimensions` shall contain the limit of the dimensions of the vehicle, as coded by the data element `VehicleDimensions` imported from ISO 17573-3;

  — the alternative `vehicleWeightLimits` shall contain the limit of the vehicle's weight, as coded by the data element `VehicleWeightLimits` imported from ISO 17573-3;

  — the alternative `axleWeightLimits` shall contain the limits of the weight on the vehicle's single axles, as coded by the data element `AxleWeightLimits` imported from ISO 17573-3;

  — the alternative `passengerCapacity` shall contain the limits of the weight on the vehicle's single axles, as coded by the data element `PassengerCapacity` imported from ISO 17573-3;

  — the alternative `exhaustEmissionValues` shall contain the exhaust emission limits of the vehicle, as coded by the data element `ExhaustEmissionValues` imported from ISO 17573-3;

  — the alternative `dieselEmissionValues` shall contain the exhaust emission limits of the vehicle, as coded by the data element `DieselEmissionValues` imported from ISO 17573-3;

  — the alternative `soundLevel` shall contain the limits of the vehicle's sound emission, as coded by the data element `SoundLevel` imported from ISO 17573-3.

7.2.31 Zone

The data frame `Zone` shall contain the definition of a zone according to one of the following options:

— the alternative `segment-carriagewayOrLane` shall contain the definition of a road segment corresponding to either the entire carriageway, or to all regular driving lanes of one traffic direction or to a single lane, modelled by an open polygonal line, as coded by the data frame `Segment`;

— the alternative `area` shall contain the definition of a polygonal area modelled by a closed polygonal line, as coded by the data frame `PolygonalLine`;

— the alternative `computedSegment` shall contain the definition of a road segment, as computed from another already defined adjacent road segment, as coded by the data frame `ComputedSegment`.

— the alternative `segment-setOfLanes` shall contain the definition of a road segment as a set of lanes modelled by an open polygonal line, as coded by the data frame `SegmentExtended`.

7.2.32 Data frames which are lists

The data frame `AbsolutePositions` shall contain a list of data frames `AbsolutePosition`.

The data frame `AbsolutePositionsWAltitude` shall contain a list of data frames `AbsolutePositionWAltitude`.

The data frame `AutomatedVehicleRules` shall contain a list of data frames `AutomatedVehicleRule`.

The data frame `DeltaPositions` shall contain an ordered list of data frames `DeltaPosition`.

The data frame `DeltaReferencePositions` shall contain an ordered list of data frames `DeltaReferencePosition as` imported from ETSI/TS 102 894-2.

The data frame `ConstraintTextLines1` shall contain a list of data frames `Text`, with those data frames constraint to have the component `layoutComponentId`, present, and the size of `textContent` constraint to minimum 1 and maximum 32 octets. If there is no `layout` component available, the value of `layoutComponentId` shall be set to 0.

The data frame `ConstraintTextLines2` shall contain a list of data frames `Text` with those data frames constraint to have size of `textContent` constraint to minimum 1 and maximum 32 octets. If there is no `layout` component available, the component `layoutComponentId` shall be absent.

NOTE The list of data frames `Text` in `ConstraintTextLines1` and `ConstraintTextlines2` supports up to 4 entries in its root, e.g. up to 4 rows of text, and is extensible to support more than four entries.

The data frame `ISO14823Attributes` shall contain a list of data frames `ISO14823Attribute`.

The data frame `IviContainers` shall contain a list of data frames `IviContainer`.

The data frame `IviIdentificationNumbers` shall contain a list of data elements `IviIdentificationNumber`.

The data frame `LaneConfiguration` shall contain a list of data frames `LaneInformation`.

The data frame `LaneIds` shall contain a list of data elements `Identifier1B` imported from ETSI/TS 102 894-2.

The data frame `LanePositions` shall contain a list of data elements `LanePosition` imported from ETSI/TS 102 894-2.

The data frame `LayoutComponents` shall contain a list of data frames `LayoutComponent`.

The data frame `PlatooningRules` shall contain a list of data frames `PlatooningRule`.

The data frame `RoadSignCodes` shall contain a list of data frames `RSCode`.

The data frame `SupportItems` shall contain a list of data frames `SupportItem`.

The data frame `TextLines` shall contain a list of data frames `Text`.

The data frame `TrailerCharacteristicsList` shall contain a list of data frames `TrailerCharacteristics`.

The data frame `TrailerCharacteristicsFixValuesList` shall contain a list of data frames `VehicleCharacteristicsFixValues`.

The data frame `TrailerCharacteristicsRangesList` shall contain a list of data frames `VehicleCharacteristicsRanges`.

The data frame `SaeAutomationLevels` shall contain a list of data elements `SaeAutomationLevel`.

The data frame `VehicleCharacteristicsFixValuesList` shall contain a list of data frames `VehicleCharacteristicsFixValues`.

The data frame `VehicleCharacteristicsList` shall contain a list of data frames `CompleteVehicleCharacteristics`.

The data frame `VehicleCharacteristicsRangesList` shall contain a list of data frames `VehicleCharacteristicsRanges`.

The data frame `ValidityPeriods` shall contain a list of data frames `InternationalSign-applicablePeriod` as imported from ISO 14823-1.

The data frame `ZoneIds` shall contain a list of data elements `Zid`.

NOTE The data frames defined in this clause represent the definition of data frames that were already implicitly defined in ISO/TS 19321:2015 (the first edition of this document). These data frames have now been explicitly defined for readability and technical correctness. This change does not break backwards compatibility.

7.3 Data Elements

7.3.1 BankingAngle

The data element `BankingAngle` contains the value of a banking angle from –20 degrees to 20 degrees. The value 21 indicates unavailable.

7.3.2 ComparisonOperator

The data element `ComparisonOperator` contains the logical comparison to be used in comparison of actual values to given limits. The values are defined in Table 10.

Table 10 — ComparisonOperator

Value	Name	Definition
0	greaterThan	Values shall be greater than the given limit.
1	greaterThanEqualTo	Values shall be equal to or greater than the given limit.
2	lessThan	Values shall be less than the given limit.
3	lessThanOrEqualTo	Values shall be equal to or less than the given limit.

7.3.3 Condition

The data element condition contains the condition of the road surface in relation to the atmospheric conditions. The values are defined in Table 11.

Table 11 — Condition

Value	Name	Definition
0	dry	The road surface is not covered by any form of H_2O.
1	moist	The road surface is covered by a thin water film (e.g. 0,01 to 0,20 mm).
2	wet	The road surface is covered by a water film (e.g. 0,20 to 2,00 mm).
3	standingWater	The road surface is covered by a thick water film (e.g. > 2,00 mm).
4	frost	The road surface is covered by frost.
5	ice	The road surface is covered by ice.
6	snow	The road surface is covered by snow.
7	slush	The road surface is covered by slush, i.e. snow mixed with water.
8	unavailable	Road surface condition information is unavailable.

7.3.4 DefinitionAccuracy

The data element `DefinitionAccuracy` contains the absolute accuracy of the definition of the zone in the Location Container for the 95 % confidence level. The values are defined in Table 12.

Table 12 — DefinitionAccuracy

Value	Name	Definition
0	oneCm	The accuracy is equal to or less than 0,01 m.
1	twoCm	The accuracy is equal to or less than 0,02 m.
2	fiveCm	The accuracy is equal to or less than 0,05 m.
3	tenCm	The accuracy is equal to or less than 0,10 m.
4	twentyCm	The accuracy is equal to or less than 0,20 m.

Table 12 *(continued)*

Value	Name	Definition
5	fiftyCm	The accuracy is equal to or less than 0,50 m.
6	oneMeter	The accuracy is equal to or less than 1,00 m.
7	Unavailable	The accuracy is unavailable.

7.3.5 Depth

The data element `Depth` contains the thickness of ice or depth of water on the road surface measured in 1/10th of millimetres from 0,0 to 25,4 millimetres. The value 255 indicate that the value is unavailable.

7.3.6 Direction

In this edition of this document the data element `Direction` is imported from ETSI/TS 102 894-2 in a backwards compatible manner.

7.3.7 DriverCharacteristics

The data element `DriverCharacteristics` contains classes of driver characteristics to which the Application Container is applicable. The values are defined in Table 14.

Table 14 — DriverCharacteristics

Value	Name	Usage
0	unexperiencedDrivers	Indicates the class of drivers who are unexperienced according to the regulation in place.
1	experiencedDrivers	Indicates the class of drivers who are experienced according to the regulation in place.

7.3.8 FrictionCoefficient

The data element `FrictionCoefficient` shall contain the friction coefficient of the dry road surface with a reference tyre under reference conditions, in one-hundredths. The value 0 shall indicate 0 and the value 100 shall indicate 1. The value 101 shall indicate that the value is unavailable.

7.3.9 GapBetweenVehicles

The data element `GapBetweenVehicles` contains the gap between vehicles measured from the rear bumper of the preceding vehicle to the front bumper of the following automated vehicle, expressed in metres.

7.3.10 GoodsType

The data element `GoodsType` specifies the type of goods of the vehicle. The values are defined Table 15.

Table 15 — GoodsType

Value	Name	Usage
0	ammunition	Transport of ammunition.
1	chemicals	Transport of chemicals of unspecified type.
2	empty	Empty load.
3	fuel	Transport of fuel of unspecified type.
4	glass	Transport of glass.
5	dangerous	Transport of materials classified as being of a dangerous or hazardous nature.

Table 15 *(continued)*

Value	Name	Usage
6	liquid	Transport of liquids of an unspecified nature.
7	liveStock	Transport of livestock.
8	dangerousForPeople	Transport of materials classed as being dangerous to people or animals.
9	dangerousForTheEnvironment	Transport of materials classed as being potentially dangerous to the environment.
10	dangerousForWater	Transport of materials classed as being dangerous when exposed to water.
11	perishableProducts	Transport of fresh products or produce that will significantly degrade in quality or freshness over a short period of time.
12	pharmaceutical	Transport of pharmaceutical materials.
13	vehicles	Transport of vehicles of any type.

7.3.11 IviIdentificationNumber

The data element `IviIdentificationNumber` contains the identifier of the IVI structure.

7.3.12 IviLaneWidth

In this edition of this document, the former data element `IviLaneWidth` is imported as `LaneWidth` from ETSI/TS 102 894-2 in a backwards compatible manner.

7.3.13 IviPurpose

The data element `IviPurpose` provides the purpose of the IVI for further usage by the receiving ITS-S. The values are defined in Table 16.

Table 16 — IVIPurpose

Value	Name	Usage
0	safety	IVI provided for road safety purposes such as in case of incidents or weather conditions.
1	environmental	IVI provided for environmental purposes such reduction of air or noise pollution.
2	trafficManagement	IVI provided for traffic management purposes such as ensuring optimal traffic flow in case of dense traffic.

7.3.14 IviStatus

The data element `IviStatus` contains the status of the IVI structure. The values are defined in Table 17.

Table 17 — IviStatus

Value	Name	Usage
0	new	Indicates that the IVI structure is sent out in its first edition.
1	update	Indicates that the IVI structure is sent out as an update of an IVI structure already sent out.
2	cancellation	Indicates that the IVI is cancelled by the service provider that provided it.
3	negation	Indicates that the IVI is negated by an authorized service provider that is different from the one that provided it.

7.3.15 IviType

The data element `IviType` provides the type of IVI to allow for classification and prioritization of IVI at the receiving ITS-S. The values are defined in Table 18.

Table 18 — IviType

Value	Name	Usage
0	Immediate danger warning messages	Information regarding immediate danger warning.
1	Regulatory messages	Information regarding regulatory messages.
2	Traffic-related information messages	Traffic-related information which is not linked to immediate danger.
3	Pollution messages	Information messages and warning messages excluding driving prohibitions and obligations.
4	Not traffic-related information messages	Other information not linked to the traffic.
5	Machine-readable messages	Information to be processed by automated driving systems.

7.3.16 LaneDelimitation

The data element `LaneDelimitation` contains the type of lane delimitation. The values are defined in Table 19.

Table 19 — LaneDelimitation

Value	Name	Usage
0	noDelimitation	The lane has no delimitation.
1	lowLaneSeparator	The lane is delimited by a continuous or discontinuous separator of total height inferior to 10 cm.
2	highLaneSeparator	The lane is delimited by a discontinuous separator of total height superior to 10 cm.
3	wall	The lane is delimited by a continuous separator of height superior to 10 cm.
4	curb	The lane is delimited by the curb of e.g. a sidewalk.
5	unpaved	The lane is delimited by an unpaved terrain.
6	guardrail	The lane is delimited by a guard rail.

7.3.17 LaneId

In this edition of this document, the former data element `LaneId` is imported as `Identifier1B` from ETSI/TS 102 894-2 in a backwards compatible manner.

7.3.18 LaneMarkingStatus

The data element `LaneMarkingStatus` provides information about the status of the lane markings in the following way: the value `TRUE` indicates that the existing lane markings are valid for traffic; the value `FALSE` indicates that the existing lane markings are not valid for traffic.

7.3.19 LaneStatus

The data element `LaneStatus` provides information on the status of the lanes with regards to traffic. The values are defined in Table 20.

Table 20 — LaneStatus

Value	Name	Usage
0	Open	Lane is open to traffic according to its type defined in LaneType.
1	Closed	Lane is closed to traffic.
2	mergeR	Lane is merging into the right adjacent lane and is closed at the end.
3	mergeL	Lane is merging into the left adjacent lane and is closed at the end.
4	mergeLR	Lane is merging into both the left and right adjacent lanes and is closed at the end.
5	provisionallyOpen	Lane is only provisionally open to normal traffic, e.g. hard shoulder open to traffic.
6	diverging	Lane is diverging to left and right, e.g. due to obstacle or road works.

7.3.20 LaneType

In this edition of this document, the data element `LaneType` is imported from ETSI TS 102 894-2 in a backwards compatible manner.

7.3.21 MarkingColour

The data element `MarkingColour` contains the colour of the lane markings. The values are defined in Table 22.

Table 22 — MarkingColour

Value	Name	Usage
0	white	Lane markings are in white.
1	yellow	Lane markings are in yellow.
2	orange	Lane markings are in orange.
3	red	Lane markings are in red.
4	blue	Lane markings are in blue.
7	unavailable	Lane marking colour information is unavailable.

7.3.22 MaterialType

The data element `MaterialType` contains the type of material of the road surface. The values are defined in Table 23.

Table 23 — MaterialType

Value	Name	Usage
0	asphalt	Road surface is made of asphalt.
1	concrete	Road surface is made of concrete.
2	cobblestone	Road surface is made of cobblestones.
3	gravel	Road surface is made of gravel.
7	unavailable	Road surface material information is unavailable.

7.3.23 MaxLenghtOfPlatoon

The data element `MaxLenghtOfPlatoon` contains the length of the platoon from the front bumper of the platoon leader to the rear bumper of the last following vehicle, expressed in decametres (dam).