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ISO/DTS 19321

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

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 be transmitted 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 and 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

[ISO/DTS 19321](https://standards.iteh.ai/ISO/DTS/19321)

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 ISO/DTS 19321
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](#).

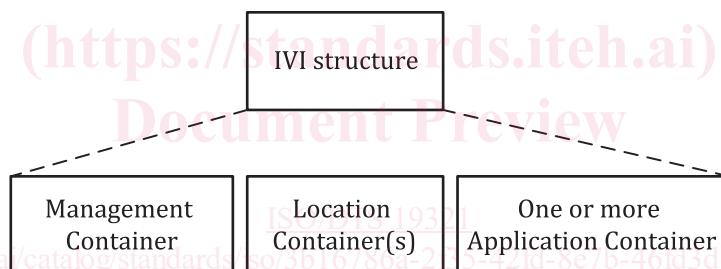


Figure 1 — IVI structure

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).

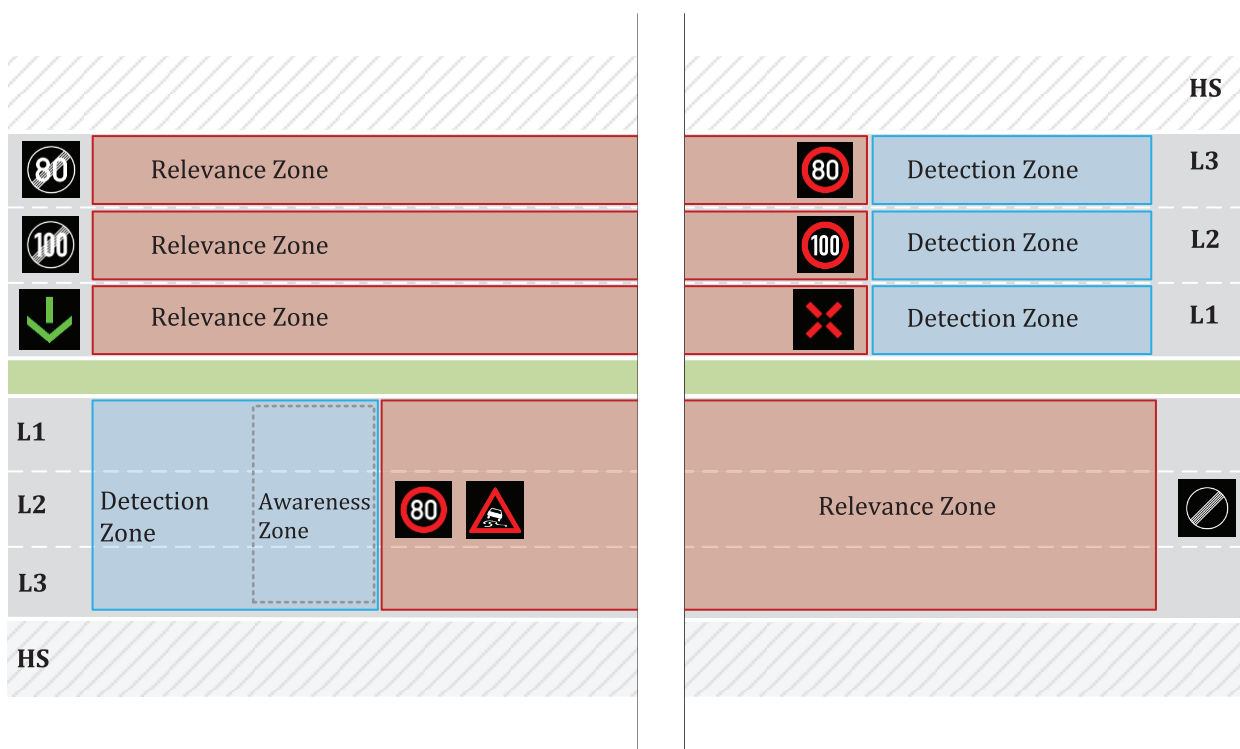


Figure 2 — Spatial validity for IVI: Detection and relevance zones

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.

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<https://standards.iteh.ai/catalog/standards/iso/3b16786a-2f35-42fd-8e7b-46fd3d125d0d/iso-dts-19321>

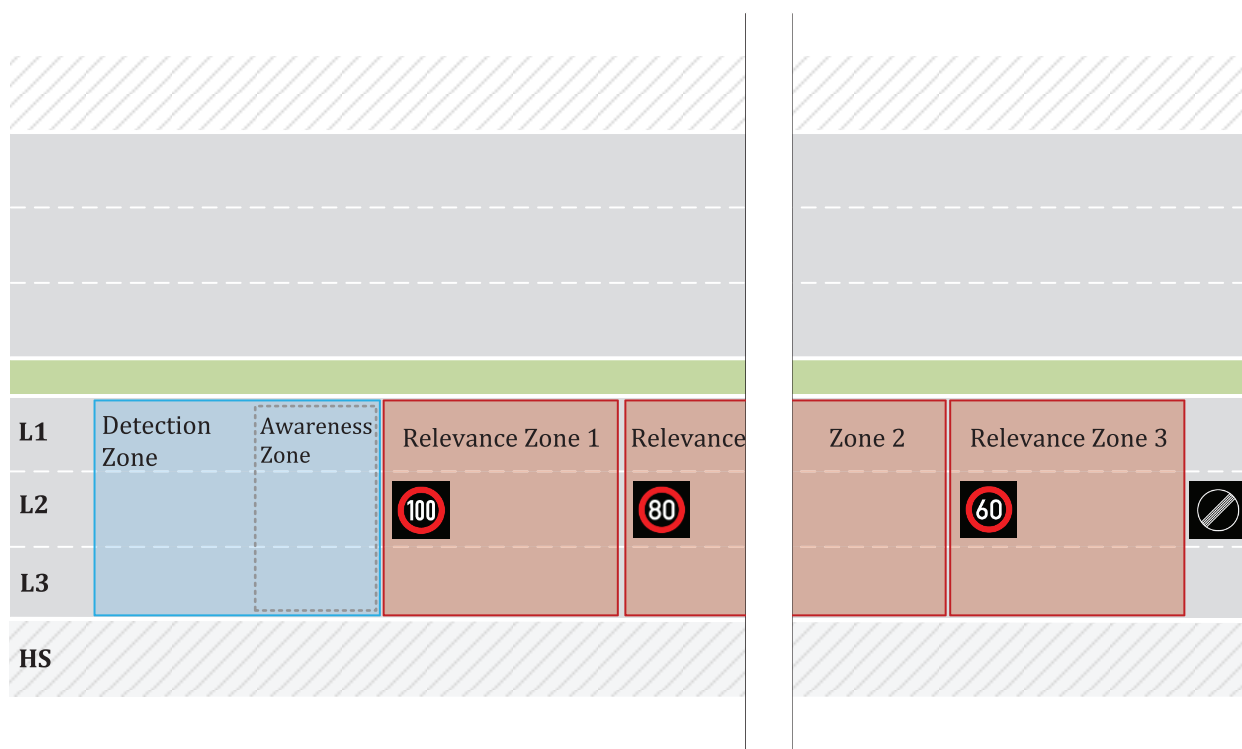


Figure 3 — Adjacent relevance zones

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`.