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

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A list of organizations represented on this committee can be obtained on request to its secretary.

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SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

# CEN ISO/TS 19321

April 2015

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English Version

## Intelligent transport systems - Cooperative ITS - Dictionary of in-vehicle information (IVI) data structure (ISO/TS 19321:2015)

Systèmes intelligents de transport - Coopérative STI - Dictionnaire de structures de données d'informations dans les véhicules (IVI) (ISO/TS 19321:2015)

Intelligente Transportsysteme - Kooperative ITS - Beschreibungsverzeichnis fahrzeuginterner Informationen von Datenstrukturen (IVI) (ISO/TS 19321:2015)

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## Foreword

This document (CEN ISO/TS 19321:2015) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems” the secretariat of which is held by NEN, in collaboration with Technical Committee ISO/TC 204 “Intelligent transport systems”.

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# Foreword

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

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

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# Introduction

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

This Technical Specification provides a toolbox of information elements for IVI. It can be used to fulfil the requirements of the service provider considering the needs of 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 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 Technical Specification 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 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. The IVI Structure is intended to be profiled to fulfil the requirements of a specific service.

This Technical Specification refers to ISO/TS 14823 as one system of standardized codes for existing road signs codes. Note that ISO/TS 14823 does not contain codes for specific national or regional signs which are not commonly used. ISO/TS 14823 also does not represent a catalogue of road sign pictograms for all applicable nations.


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

## 1 Scope

This Technical Specification specifies the in-vehicle information (IVI) data structures that are required by different ITS services (for example, refer to ISO/TS 17425 and ISO/TS 17426) for exchanging information between ITS Stations. A general, extensible data structure is specified (see Clause 5). This is split into structures called containers to accommodate current-day information (see Clause 6). Transmitted information includes IVI such as contextual speed, road works warnings, vehicle restrictions, lane restrictions, road hazards warnings, location-based services, re-routing, etc. The information in the containers is organized in sub-structures called data frames and data elements which are described in terms of its content (see Clause 7) and its syntax (see Annex A).

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

## 2 Normative references

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

ISO 639-1:2002, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

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

ISO 14816:2005, *Road transport and traffic telematics — Automatic vehicle and equipment identification — Numbering and data structure*

ISO 14906:2011, *Electronic fee collection — Application interface definition for dedicated short-range communication*

ISO/IEC 8824-1:2008, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

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

ETSI/TS 102 894-2 V1.1.12, *Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary*

## 3 Terms and definitions

**3.1**
**application data unit**
data unit exchanged between ITS-S applications

**3.2**
**container**
group of *data frames* (3.4) and data elements semantically belonging together in one place in the IVI structure

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**3.3**
**data element**
data type that contains one single data

[SOURCE: ETSI/TS 102 894-2 V1.1.1]

**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 V1.1.1]

**3.5**
**detection zone**
part of the road network that is passed by a vehicle in approach of the *relevance zone* (3.12)

**3.6**
**driver awareness zone**
parts of road network on which a message is presented to inform drivers about upcoming situations

Note 1 to entry: This definition will be aligned with ISO/TS 17425.

**3.7**
**in-vehicle information**
information contained in the In-vehicle Information (IVI) data structure that is required by different ITS services

**3.8**
**in-vehicle signage**
ITS service that provides static, as well as dynamic road sign and message sign information to drivers

Note 1 to entry: This definition will be aligned with ISO/TS 17425.

**3.9**
**International Terrestrial Reference Frame**
realisation of the ITRS

[SOURCE: ISO 17572-1:2008]

**3.10**
**International Terrestrial Reference System**
reference system for the earth derived from precise and accurate space geodesy measurements not restricted to GPS Doppler measurements which is periodically tracked and revised by the International Earth Rotation Service

[SOURCE: ISO 17572-1:2008]

**3.11**
**Minimum Dissemination Area**
parts of the road network where the IVS message can be received by the potentially targeted vehicles

Note 1 to entry: This definition will be aligned with ISO/TS 17425.

**3.12**
**Relevance Zone**
parts of the road network for which the information in an Application Container is valid

[SOURCE: ISO/TS 17425]

**3.13**
**road hazard warning**
ITS service that provides road hazard information to drivers


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**3.14**
**Road Works Warning**
alerts for routing road users around road construction and/or road repair

**3.15**
**Variable Message Sign**
electronic sign board presenting text, symbols, or a combination of them

## 4 Abbreviated terms

The following abbreviations are used in this document.

| | |
|---|---|
| ADR | European Agreement concerning the International Carriage of Dangerous Goods by Road |
| ASN.1 | Abstract Syntax Notation One |
| BLOB | Binary Large Object |
| DAZ | Driver Awareness Zone |
| DE | Data Element |
| DENM | Decentralized Environmental Notification Message |
| DF | Data Frame |
| ETRF | European Terrestrial Reference Frame |
| HOT | High-Occupancy Toll (lane) |
| HOV | High-Occupancy Vehicle |
| ID | Identification |
| ITRF | International Terrestrial Reference Frame |
| ITRS | International Terrestrial Reference System |
| ITS | Intelligent Transport Systems |
| ITS-S | ITS Station |
| IVI | In-vehicle Information |
| IVS | In-vehicle Signage |
| MDA | Minimum Dissemination Area |
| OEM | Original Equipment Manufacturer |
| POI | Point of Interest |
| RZ | Relevance Zone |
| RWW | Road Works Warning |
| VMS | Variable Message Sign |

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# 5 In-vehicle Information (IVI) data structure

## 5.1 Structural model

### 5.1.1 General model

The IVI Structure represents the Application Data Unit to be transmitted and received by an ITS-Station (ITS-S). The IVI Structure shall comply with the syntax defined in Annex A as the data type `IviStructure`. This means that it shall be composed of Containers defined in this Technical Specification and follow the form depicted in Figure 1.

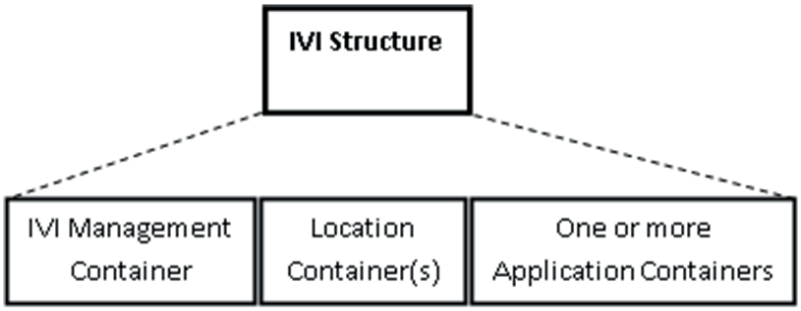


**Figure 1 — IVI Structure**

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 Technical Specification

The IVI Structure shall contain a Management Container. The information in the IVI Management Container is applicable to the entire IVI Structure. This Container is mandatory to be present and 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 IVI Application Containers. Location Containers can carry information relevant for different IVI 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 IVI Application Container(s). The IVI 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 Reference Zones. Each Application Container refers to zones defined in the Location Container identified by their IDs for the following usage: 1) Detection Zone, 2) Relevance Zone, and 3) Driver Awareness Zone. An Application Container may optionally provide information about the minimum awareness time, that is, the minimum time that 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 is able to interpret the application information in the context of the appropriate location information. Principally, there are four conceptual zones:

1) Minimum Dissemination Area (MDA);

2) Detection Zone;


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3) Driver Awareness Zone (DAZ);

4) Relevance Zone (RZ).

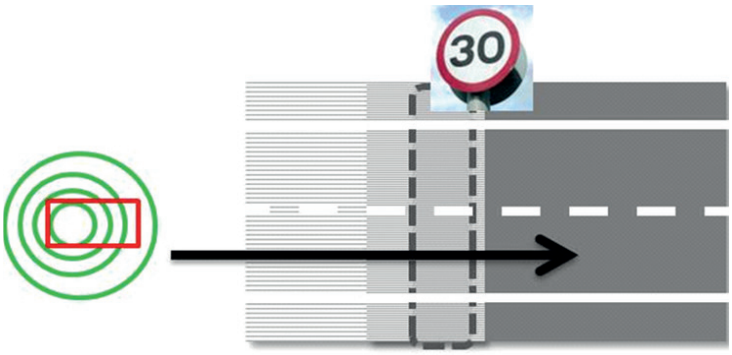
The MDA refers to the minimum area where the IVI Structure is disseminated by an ITS-S based on application requirements. The MDA is defined in the relevant application standards or specification(s) and is therefore out of scope of this Technical Specification.

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

The IVI can be used to inform drivers about upcoming situations in the DAZ. The DAZ can be determined by the receiving ITS-S because the DAZ 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 DAZ can be provided by the sending ITS-S for usage by the receiving ITS-S.

The final zone and the Relevance Zone covers the area where the IVI is applicable.

Examples of the Detection and Relevance Zones for the spatial validity of the IVI Structure are illustrated in Figure 2. The Driver Awareness Zone (outside the scope of this Technical Specification) can be physically overlapping with the Detection Zone (but is not necessarily equal in size).




**Key**

minimum dissemination area (not transmitted)

detection zone

driver awareness zone

relevance zone

**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, from left to right, the first zone represents a Detection Zone and the second zone represents a Relevance Zone.

In Figure 3, from left to right, the first zone represents a Detection Zone. The second zone then represents Relevance Zone 1, but this same zone also serves as a Detection Zone for Relevance Zone 2.

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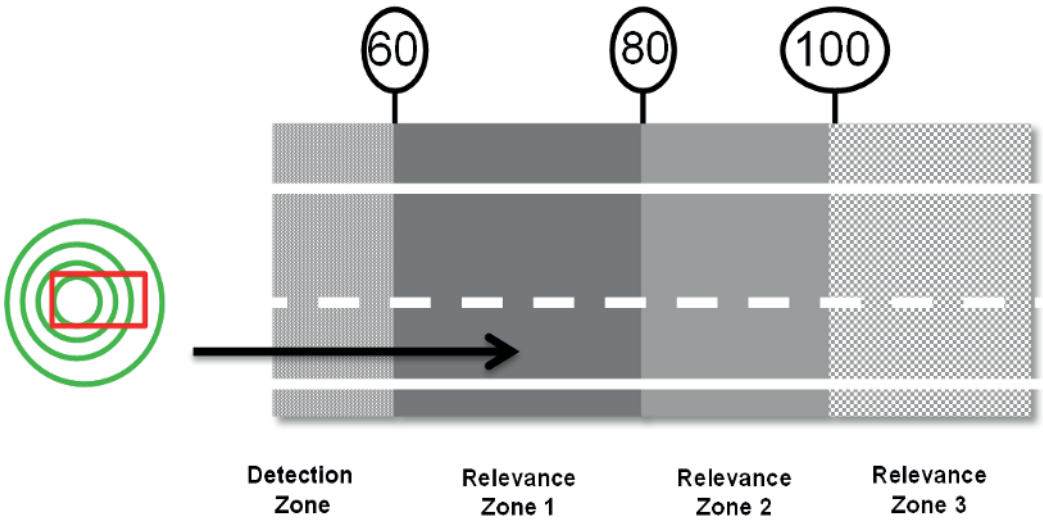


**Figure 3 — Concatenated Relevance Zones**

## 5.2 Location referencing

### 5.2.1 General

There are essentially two different ways of referencing road locations. It is called map-based location referencing in this Technical Specification when referencing attributes of the road network itself. It is called geographic location referencing in this Technical Specification when referencing a regular or irregular division of space which exists independent of the representation of the road network.

### 5.2.2 Geographic positioning

Geographic location systems or coordinate systems are location maps composed of imaginary, intersecting lines forming a grid. Coordinate values of the grid, expressed as numeric or alphanumeric characters, are used to describe a position.

To translate position data expressed in longitude, latitude, and height to the corresponding real position on earth or vice-versa, the earth-centred, earth-fixed, polar-coordinate geodetic datum WGS84 (G1150) according to NIMA TR8350.2 Version 3 shall be used. Alternatively, any earth-centred, earth-fixed polar coordinate geodetic datum can be used as long as the maximum datum displacement relative to the geodetic datum agreed on, or relative to WGS84 (G1150) in case of no agreement, is acceptable to the application.

NOTE A suggested tolerance of 0.3 meters in datum displacement (also called datum shift) is intended, for example, to allow for using the International Terrestrial Reference Frame (ITRF) or the European Terrestrial Reference Frame (ETRF) geodetic datum as alternative to the WGS84. Datum displacements are suggested to be calculated according to the definitions in ASME Y14.5 – 2009.

An ITS-S sending an IVI Structure provides one or more Reference Point(s). The Reference Point can be the reference for the description of a static zone or a dynamic (moving) zone. The zone can be described by a polygonal line which delineates a segment or an area, or can be described by a distance value indicating the extension of the relevance zone from the Reference Position and the heading relative to the Reference Position.

The detection zone can optionally be provided as a polygonal line in approach to the Reference Position. If the Reference Position is the position of a moving object, the polygonal line is represented by the last positions of the path of the moving object (e.g. the trace of a roadworks vehicle).

Determining the relevance of IVI is carried out by referencing the location of a receiving ITS-S relative to a reference in a coordinate-based system.


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As a vehicle progresses, its motion creates a series of points. The series, when assembled as a set, trace the path of the vehicle. The path enables a receiving ITS-S to detect the applicability of a Relevance Zone and the approach into a Relevance Zone.

### 5.2.3 Map-based location referencing

Determining the relevance of IVI can also be carried out by referencing the location of a receiving ITS-S relative to a map reference (refer to ISO 17572-1). This can be a global map available in the receiving ITS-S or it can be a local map distributed in the same dissemination area as IVI.

Map-based location referencing can be incorporated in future revisions of this Technical Specification.

# 6 IVI Containers

## 6.1 IVI Management Container

### 6.1.1 Definition

IVI 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 IVI Management Container. The syntax is defined in Annex A as mandatory component of the data type `IviStructure`.

**Table 1 — IVI Management Container**

| Container | Component | M/O[a] | Description |
|---|---|---|---|
| IVI Management Container | `serviceProviderId` | M | Identifies the organization that provided the IVI by using the DE `Provider`; contains a country code according to ISO 3166-1. Numbers shall be assigned on national basis. See ISO 14816 for registration. |
| | `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. |
| | `validFrom` | O | Start time of the validity period of the message. |
| | `validTo` | O | End time of the validity period of the message. |
| | `connectedIviStructures` | O | List of other `iviIdentificationNumber` identifying other IVI Structures of the same authority which are connected to the IVI Structure using the DE `IviIdentificationNumber`. |
| | `iviStatus` | M | Status of the IVI Structure using the DE `IviStatus`. |

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

### 6.1.2 Usage — IVI Management Container

The sending ITS-S shall include the component `serviceProviderId`, `iviIdentificationNumber`, and can include the component `timeStamp`. The organization providing the IVI (e.g. the Service Provider, as defined in ISO/TS 17427) should apply for a `serviceProviderId`.

NOTE 1 For detailed information, see http://www.itsstandards.eu/index.php?option=com_content&view=article&id=186&Itemid=151

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The `iviIdentificationNumber` in the IVI 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.

The component `timeStamp` should identify different versions of the IVI Structure due to updates managed by the Service Provider. This component should be included if the sending ITS-S foresees to send updates of the IVI Structure.

The sending ITS-S can include the components `validFrom` and `validTo`.

The sending ITS-S 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.

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

— new, that is, if the `iviStatus` is “new” and/or if the combination of `serviceProviderId` and `iviIdentificationNumber` is different from other received messages;

— update of a received IVI Structure, that is, if the `iviStatus` is “update” and/or if the combination of `serviceProviderId` and `iviIdentificationNumber` equals to those from another received structure and the timestamp is more recent;

— duplicate of a received structure, that is, if the `iviStatus` is “update” and/or if the combination of `serviceProviderId` and `iviIdentificationNumber` equals to those from another received structure and the timestamp is the same;

— cancellation, that is, if the `iviStatus` is “cancellation”;

— negation, that is, 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 Technical Specification.

The Service Provider can divide the IVI in structures of appropriate size in relation to the capabilities of the communication technology and connect those IVI Structures belonging together.

A sending ITS-S 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-S.

EXAMPLE Vehicles to which special regulations apply (such as heavy vehicles) may 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 must 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.

NOTE 2 The identification of the ITS-S (ITS-S ID) is not contained in the IVI Management Container because it is protocol layer information which is contained, for example, in the ITS PDU Header. Additionally, 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 IVI Location Container

### 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.


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