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# Intelligent transport systems — Indoor navigation for personal and vehicle ITS station —

## Part 4: Requirements and specifications for interface between personal/vehicle and central ITS stations

*Systèmes de transport intelligents — Navigation interne pour station personelle et véhicule ITS —*

*Partie 4: Exigences et spécifications de l'interface entre les stations personnelle/véhicule et centrale ITS*



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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 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

For a list of all the parts in the ISO 17438 series, see the ISO website www.iso.org.

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

With the spread of nomadic and mobile devices such as smart phones and the rapid expansion of indoor spaces, many of the services and facilities related to the transport system have become accessible to indoor spaces. Consequently, navigation in indoor space is considered a new killer application in the transport industry.

The objective of this document is to provide message specifications required for indoor navigation functionality. This document is intended to be used by designers, developers and providers of indoor navigation services. This document defines use cases, requirements and message specifications for supporting indoor navigation in intelligent transport systems. When implemented, this document will:

1) Provide developers and designers with concepts and appropriate information to implement indoor navigation service;

2) Provide developers and designers with interoperable ways to use indoor navigation data from various sources for indoor navigation;

3) Enable users to be provided with indoor navigation;

4) Provide developers and designers with an extendable base for indoor navigation.

# Intelligent transport systems — Indoor navigation for personal and vehicle ITS station —

# Part 4: Requirements and specifications for interface between personal/vehicle and central ITS stations



## 1 Scope

This document defines detailed use cases, requirements and message specifications for supporting indoor navigation functionality between a personal/vehicle (P/V) ITS station and a central ITS station.

This document defines:

a) Clusters of use cases based on processing flows for indoor navigation between a P/V ITS station and a central ITS station;

b) Detailed use cases derived from the clusters of use cases for indoor navigation;

c) Message specifications to support some of the detailed use cases. The message specifications include mandatory, conditional and optional elements.

This document is only applicable to the core flow for the navigational functionality in indoor space. The following issues which are adjunctive but essential for commercial navigation services are beyond the scope of this document:

— Authorized and authenticated access of users and services, including security;

— Payment;

— Preparation of indoor data which are necessary for indoor navigation;

— Detailed data formats for indoor navigation data, including indoor maps and indoor positioning references (these form a part of ISO 17438-2[1)] and ISO 17438-3[2)]);

— How to transfer and share data required for indoor navigation between a roadside ITS station and a central ITS station, i.e. low-level communication protocols;

— Other issues dependent on implementation of an instance of indoor navigation, e.g. indoor-outdoor seamless navigation.

This document uses the XML and Data eXchange Message (DXM) format defined in ISO 13184-2 to encode defined messages.

## 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.

1) Under development. Current stage 0.00.

2) Under development. Current stage 0.00.

ISO 13184-2, *Intelligent transport systems (ITS) — Guidance protocol via personal ITS station for advisory safety systems — Part 2: Road guidance protocol (RGP) requirements and specification*

ISO 17423, *Intelligent transport systems — Cooperative systems — Application requirements and objectives*

ISO/TS 17429, *Intelligent transport systems — Cooperative ITS — ITS station facilities for the transfer of information between ITS stations*

ISO 17438-1, *Intelligent transport systems — Indoor navigation for personal and vehicle ITS station — Part 1: General information and use case definition*

# 3 Terms, definitions, symbols and abbreviated terms

## 3.1 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 13184-2 and ISO 17438-1 and the following apply.

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

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

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

**3.1.1**
**indoor space**
space within artificial structures such as buildings and facilities connected with transport corridors or roads

EXAMPLE A building or indoor parking lot.

**3.1.2**
**indoor navigation**
navigation provided in indoor space

**3.1.3**
**ITS station**
**ITS-S**
entity in a communication network, comprised of application, facilities, networking and access layer components specified in ISO 21217 that operate within a bounded secure management domain

[SOURCE: ISO 13184-2:2016, 3.5]

**3.1.4**
**personal/vehicle ITS station**
**P/V-ITS-S**
ITS station implemented in a vehicle or mobile device

**3.1.5**
**roadside ITS station**
**R-ITS-S**
system that receives and processes vehicular and pedestrian information within a certain zone

Note 1 to entry: The system is installed at the roadside.

**3.1.6**
**central ITS station**
**central ITS-S**
**C-ITS-S**
implementation of an ITS-S in a central ITS subsystem



 

**3.1.7**
**indoor positioning**
determination of a location in an indoor space

**3.1.8**
**client-based indoor positioning**
indoor positioning executed at a personal/vehicle ITS station (P/V-ITS-S)

**3.1.9**
**server-based indoor positioning**
indoor positioning executed at a central ITS station (C-ITS-S)

**3.1.10**
**indoor map**
map required for indoor navigation, which includes an indoor POI map, an indoor network map, an indoor cell map, and an indoor background map

**3.1.11**
**indoor positioning infrastructure**
infrastructure used to determine locations of personal/vehicle ITS stations (P/V-ITS-S) in an indoor space

EXAMPLE Wi-Fi, Bluetooth, etc.

**3.1.12**
**indoor positioning reference**
information to support indoor positioning

Note 1 to entry: Detailed specifications and contents of indoor positioning references depend on the specific indoor positioning technologies.

EXAMPLE 1 A good example of an indoor positioning reference is information about indoor positioning infrastructure.

EXAMPLE 2 For Wi-Fi based positioning, the indoor positioning infrastructure information includes the Wi-Fi APs information, such as location, SSID, and RSSI values of APs.

**3.1.13**
**indoor navigation data**
data needed for indoor navigation, which includes indoor maps and indoor positioning infrastructure information

## 3.2 Abbreviated terms

| | |
|---|---|
| ITS | Intelligent Transport Systems |
| ITS-S | ITS Station |
| P/V-ITS-S | Personal/Vehicle ITS Station |
| R-ITS-S | Roadside ITS Station |
| C-ITS-S | Central ITS Station |
| CRD | Cardinality |
| CRS | Coordinate Reference System |
| DXM | Data eXchange Message (from ISO 13184-2) |
| EPSG | European Petroleum Survey Group |

| | |
|---|---|
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| M/O | Mandatory/Optional |
| MO | Maximum Occurrence |
| POI | Point of Interest |
| SI | International System of Units |
| XML | eXtensible Markup Language |
| WLAN | Wireless Local Area Network |

# 4 Conformance

## 4.1 Conformance requirements

For conformance with this document, the requirements described in Clause 9 shall be met.

## 4.2 Obligation and conditions

For the purpose of conformance tests according to Clause 9, the elements in a message shall be considered to be mandatory, conditional or optional as specified in this document.

# 5 Conventions

This document is based on the conventions of XML and DXM (Data eXchange Message) formats defined in normative references.

# 6 Overview of indoor navigation

## 6.1 Indoor navigation

Indoor navigation involves indoor spaces with routes of navigation. Figure 1 shows an indoor navigation implementation environment and ITS entities that compose this environment.

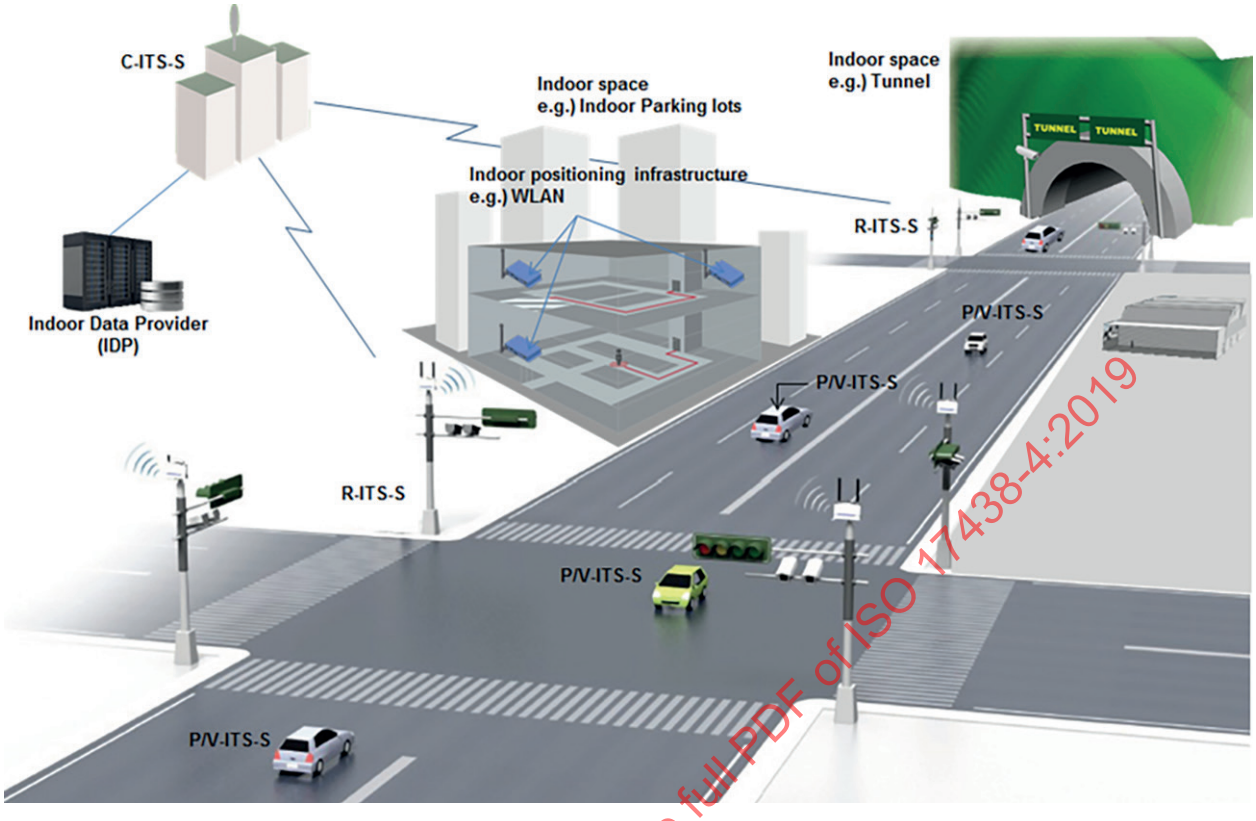


**Figure 1 — Concept of indoor navigation**

Because of the existence of indoor spaces, to provide navigation functionality, indoor navigation requires access to more data:

— Indoor positioning reference

  Unlike GNSS, many indoor positioning technologies require additional data to support positioning. For example, indoor positioning using WiFi or WLAN infrastructure, which is most frequently mentioned, requires information related to access point devices installed in target indoor spaces or a radio-signal fingerprint map constructed in the target indoor spaces. Other indoor positioning technologies, such as Bluetooth Low Energy (BLE) beacons or Radio-Frequency Identification (RFID) tags, are similar. Geomagnetic indoor positioning also requires a fingerprint map on the strength of the geomagnetic fields in the indoor spaces. Detailed composition of indoor positioning reference data is dependent on indoor positioning technologies.

— Indoor map

  Various types of indoor maps, including indoor networks, cells, POIs and background maps, are required for planning routes in indoor spaces and for guidance.

Therefore, fundamental functionalities to support indoor navigation need to include the following:

— Identification of indoor spaces to be involved in navigation;

— Search and retrieval, or access, of/to indoor maps and indoor positioning reference.

Indoor navigation can be implemented in client-based forms or server-based forms according to various aspects such as accessibility to indoor maps or indoor positioning references to each indoor space. In this document, specific use cases for client-based indoor navigation and server-based indoor navigation including the basic functionalities mentioned above are defined in Clause 7. In Clause 8, message definitions for some use cases defined in Clause 7 are shown. An example scenario of an indoor navigation using defined use cases and messages is given in Annex C.

## 6.2 Relationship to other parts of the ISO 17438 series

ISO 17438-1 defines the overall structures and use cases for indoor navigation in general. This document redefines some use cases in depth to derive definitions of message interfaces for indoor navigation between a P/V-ITS-S and a C-ITS-S.

— Identification of indoor spaces;

— Search and retrieval of indoor maps and indoor positioning references;

— Client-based and server-based indoor navigation.

This document focuses on how to access indoor navigation data to support indoor navigation functionalities, not on a specific type or form of implementation. Therefore, message interfaces to access indoor navigation data are defined in this document and detailed message formats for specific implementation related to normal outdoor navigation are not covered. For example, some messages required for flow controls in server-based navigation, such as setting waypoints, route planning, start/termination of route guidance, which can be given through normal, outdoor server-based navigation, are not defined in this document.

This document assumes that all information and data, including indoor spaces, indoor maps, and indoor positioning references, exist at a C-ITS-S. Although some information and data can be provided by an external data provider case by case, generally it can be supported through a C-ITS-S.

Moreover, further information is contained in other parts of ISO 17438, for example:

— Indoor map types and the format itself

  These issues are within the scope of ISO 17438-2 including how to connect indoor network maps and outdoor network maps. Although some names for types of data related to types of indoor maps and formats are mentioned in this document, they are defined in more detail or re-defined in ISO 17438-2.

— Indoor positioning types of reference and formats

  These issues are within the scope of ISO 17438-3. Although some names for types of data related to types of indoor positioning reference and formats are mentioned in this document, they are defined in more detail or re-defined in ISO 17438-3. More details about the relationship between this document and ISO 17438-2 and ISO 17438-3 are given in Annex D.

  There can be many forms of implementation for indoor navigation and several issues that are out of the scope of this document that should be considered upon implementation.

— Indoor-outdoor seamless navigation

  A key factor of indoor-outdoor seamless navigation is switching from indoor positioning to outdoor positioning and vice versa. How to switch between indoor positioning and outdoor positioning differ case to case depending on navigation environments and implementations.



# 7 Use case definitions

## 7.1 Use case clusters overview

Table 1 provides an overview of use cases for indoor navigation. The use cases are grouped into use case clusters.

**Table 1 — Overview of use case clusters**

| # Title of use case cluster | Brief description | Related use cases in ISO 17438-1 |
|---|---|---|
| 1. Identification of Indoor spaces | This cluster describes use cases that identify indoor spaces involved during indoor navigation.<br>UC 1.1 searching for indoor POIs<br>UC 1.1 searching for indoor spaces | 1.5 Indoor POI search<br>1.9 Server-based indoor POI Search |
| 2. Search and retrieval of Indoor navigation data | This cluster includes use cases related to search and retrieval of indoor maps and indoor positioning reference data.<br>UC 2.1 searching for indoor maps<br>UC 2.2 retrieving indoor maps<br>UC 2.3 searching for indoor positioning references<br>UC 2.4 retrieving indoor positioning reference | 1.10 Indoor map data information request<br>1.11 Indoor positioning reference data information request<br>1.12 Indoor map data download<br>1.13 Indoor positioning reference data download<br>2.4 Indoor map data provision<br>2.8 Indoor positioning reference data provision |
| 3. Client based indoor navigation | This cluster considers the scenarios in which route planning and guidance for indoor navigation are provided at the client side.<br>UC 3.1 setting waypoints at P/V-ITS-S<br>UC 3.2 route planning at P/V-ITS-S<br>UC 3.3 route guidance by P/V-ITS-S | 1.1 Indoor map display<br>1.3 Indoor route planning<br>1.4 Indoor route guidance |
| 4. Server based indoor navigation | This cluster considers the scenarios in which route planning and guidance for indoor navigation are provided at the server side.<br>UC 4.1 setting waypoints at the C-ITS-S<br>UC 4.2 route planning at the C-ITS-S<br>UC 4.3 route guidance by the C-ITS-S | 1.1 Indoor map display<br>1.7 Server-based indoor route planning<br>1.8 Server-based indoor route guidance |

NOTE Some use cases of ISO 17438-1 that are not listed in Table 1 are out of the scope of this document. They are addressed in other parts. For example, use cases related to indoor positioning are addressed in ISO 17438-3.

The use cases in Table 1 are grouped into clusters according to their functionality: identification of the indoor space, retrieval of indoor navigation data and indoor positioning. Thus, indoor navigation can be provided with an effective combination of some use cases in use-case clusters, depending on the detailed scenario and implementation.

## 7.2 Descriptions of use cases

### 7.2.1 UC cluster 1 — Identification of indoor space

This use case cluster involves use cases used when a P/V-ITS-S needs to know which indoor spaces are necessary for planning a route in indoor navigation.

#### 7.2.1.1 UC 1.1 — Searching for indoor POIs

Table 2 defines the use case for searching for indoor POIs and identifying indoor spaces including the POIs.

**Table 2 — Definition of UC 1.1 — Searching for indoor POIs**

| | |
|---|---|
| **Use case cluster** | **1 — Identification of indoor space** |
| **Use case name** | **UC 1.1 — Searching indoor POIs** |
| **Description** | A P/V-ITS-S searches for indoor POIs and identifies indoor spaces in which the indoor POIs exist through a C-ITS-S. |
| **Pre-condition** | a) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>b) The P/V-ITS-S should have appropriate permission to access the C-ITS-S. |
| **Processing flows** | a) A user inputs information about indoor POIs to be searched for at the P/V-ITS-S.<br>b) The P/V-ITS-S sets search conditions[Note 1] based on the given information and requests the C-ITS-S to search for indoor POIs using the search conditions.<br>c) The C-ITS-S searches for candidates of indoor POIs that satisfy the given search conditions.<br>d) The C-ITS-S transfers the search results to the P/V-ITS-S with identifications[Note 2] of indoor spaces in which the searched for indoor POIs exist.<br>e) The P/V-ITS-S can select a POI among the transferred candidates of POIs with the user's confirmation. |
| **Note** | 1) Refer to the "`search-indoor-POIs`" message in 8.2 for the kinds and types of conditions. The available search conditions depend on the implemented service flow. Some values for search conditions can be based on the user's inputs or other data managed during indoor navigation according to the specific design and implementation.<br>2) Refer to "`indoorPOI`" and "`indoorSpace`" data types in Annex A for identification of an indoor space. |

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| b) | `search-indoor-POIs` | P/V | Sends the prepared conditions for searching for indoor POIs to the C-ITS-S. | 8.2 |
| d) | `candidates-of-indoor-POIs` | C | Sends the search results to the P/V-ITS-S. | 8.3 |
| **Note** | | | | |
| None | | | | |

### 7.2.1.2 UC 1.2 — Searching indoor spaces

Table 3 defines the use case handling of how a P/V-ITS-S finds indoor spaces to be checked for indoor navigation.

**Table 3 — Definition of UC 1.1 — Searching indoor spaces**

| | |
|---|---|
| **Use case cluster** | **1 — Identification of indoor space** |
| **Use case name** | **UC 1.2 — Searching for indoor spaces** |
| **Description** | A P/V-ITS-S searches for indoor spaces involved in preparation or execution of indoor navigation through a C-ITS-S. |
| **Pre-condition** | a) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>b) The P/V-ITS-S should have appropriate permission to access the C-ITS-S. |

**Table 3** *(continued)*

| | |
|---|---|
| **Processing flows** | a) The P/V-ITS-S prepares the conditions[Note 1] for searching for indoor spaces involved in indoor navigation.<br>b) The P/V-ITS-S requests a search for indoor spaces of the C-ITS-S using the prepared search conditions.<br>c) The C-ITS-S searches for indoor spaces that satisfy the given search conditions.<br>d) The C-ITS-S transfers the search results[Note 2] to the P/V-ITS-S.<br>e) The P/V-ITS-S can select target indoor spaces among the transferred candidates with the user's confirmation. |
| **Note** | 1) Refer to the "`search-indoor-spaces`" message in 8.4 for the kinds and types of conditions. Which search conditions are available depends on the implemented service flow. Some values for search conditions can be based on the user's inputs or other data managed during indoor navigation according to the specific design and implementation.<br>2) Refer to the "`indoorSpace`" data type in Annex A for identification of an indoor space. |

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| b) | `search-indoor-spaces` | P/V | Sends prepared conditions for searching for indoor spaces to the C-ITS-S. | 8.4 |
| d) | `candidates-of-indoor-spaces` | C | Sends the search results to the P/V-ITS-S. | 8.5 |
| **Note** | | | | |
| None | | | | |

### 7.2.2 UC cluster 2 — Indoor navigation data

This use case cluster involves use cases that handle how a P/V-ITS-S searches for indoor navigation data, including indoor maps or indoor positioning references, and how to retrieve the searched for indoor navigation data from the C-ITS-S.

#### 7.2.2.1 UC 2.1 — Searching indoor maps

Table 4 defines the use case handling of how a P/V-ITS-S searches for indoor maps with given constraints for indoor navigation.

**Table 4 — Definition of UC 2.1 — Searching indoor maps**

| | |
|---|---|
| **Use case cluster** | **2 — Indoor navigation data** |
| **Use case name** | **UC 2.1 — Searching for indoor maps** |
| **Description** | A P/V-ITS-S searches for indoor maps needed in preparation or execution of indoor navigation through a C-ITS-S. |
| **Pre-condition** | a) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>b) The P/V-ITS-S should have appropriate permission to access the C-ITS-S.<br>c) The target indoor space where the indoor maps need to be searched for should be identified beforehand[Note 1]. When the target indoor spaces are identified, types of available indoor maps are known. |

**Table 4** *(continued)*

| | |
|---|---|
| **Processing flows** | a) The P/V-ITS-S prepares conditions[Note 2] to search for indoor maps required during indoor navigation.<br>b) The P/V-ITS-S requests the C-ITS-S to search for indoor maps using the prepared conditions.<br>c) The C-ITS-S searches for indoor maps that satisfy the given search conditions.<br>d) The C-ITS-S transfers the search results[Note 3] to the P/V-ITS-S.<br>e) The P/V-ITS-S can select target indoor maps among the transferred candidates with the user's confirmation or configurations of implemented indoor navigation. |
| **Note** | 1) Identification of the target indoor space can be conducted through a use case cluster "UC 1 — Identification of indoor space".<br>2) Refer to the "`search-indoor-maps`" message in 8.6 for the kinds and types of conditions. Which search conditions are available depends on the implemented service flow. Some values for search conditions can be based on the user's inputs or other data managed during indoor navigation according to a specific design and implementation.<br>3) Refer to the "`indoorMapInfo`" data type in Annex A for attributes of an indoor map. |

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| b) | `search-indoor-maps` | P/V | Sends the prepared conditions for searching for indoor maps to the C-ITS-S. | 8.6 |
| d) | `candidates-of-indoor-map-candidates` | C | Sends the search results to the P/V-ITS-S. | 8.7 |
| **Note** | | | | |
| None | | | | |

### 7.2.2.2 UC 2.2 — Retrieving an indoor map

Table 5 defines the use case handling of how a P/V-ITS-S retrieves an indoor map required for indoor navigation.

**Table 5 — Definition of UC 2.2 — Retrieving an indoor map**

| | |
|---|---|
| **Use case cluster** | **2 — Indoor navigation data** |
| **Use case name** | **UC 2.2 — Retrieving an indoor map** |
| **Description** | A P/V-ITS-S retrieves an indoor map as needed in preparation or execution of indoor navigation through a C-ITS-S. |
| **Pre-condition** | a) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>b) The P/V-ITS-S should have appropriate permission to access the C-ITS-S.<br>c) The target indoor map to be retrieved should be identified beforehand[Note 1]. |
| **Processing flows** | a) The P/V-ITS-S prepares conditions to retrieve an indoor map required during indoor navigation.<br>b) The P/V-ITS-S requests the C-ITS-S to retrieve the target indoor map using the prepared conditions.<br>c) The C-ITS-S prepares and transfers the requested indoor map to the P/V-ITS-S.<br>d) The C-ITS-S transfers the requested indoor map[Note 2] to the P/V-ITS-S. |

**Table 5** *(continued)*

| | |
|---|---|
| **Note** | 1) The identification of the target indoor map can be conducted using use case "UC 2.1 — Searching for indoor maps".<br>2) Detailed format and specifications of an indoor map are defined in ISO 17438-2 as mentioned in Annex D. |

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| b) | `retrieve-indoor-map` | P/V | Sends the prepared conditions for retrieving an indoor map to the C-ITS-S. | 8.8 |
| d) | `indoor-map` | C | Sends the target indoor map to the P/V-ITS-S. | 8.9 |
| **Note** | | | | |
| None | | | | |

### 7.2.2.3 UC 2.3 — Searching for indoor positioning references

Table 6 defines the use case handling of how a P/V-ITS-S searches for indoor positioning references with given constraints for indoor navigation.

**Table 6 — Definition of UC 2.3 — Searching for indoor positioning references**

| | |
|---|---|
| **Use case cluster** | **2 — Indoor navigation data** |
| **Use case name** | **UC 2.3 — Searching for indoor positioning references** |
| **Description** | A P/V-ITS-S searches for indoor positioning references needed in preparation or execution of indoor navigation through a C-ITS-S. |
| **Pre-condition** | a) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>b) The P/V-ITS-S should have appropriate permission to access the C-ITS-S.<br>c) The target indoor space that needs to be searched for indoor positioning references should be identified beforehand[Note 1]. When the target indoor spaces are identified, types of available indoor positioning references are known. |
| **Processing flows** | a) The P/V-ITS-S prepares conditions[Note 2] to search for indoor positioning references required during indoor navigation.<br>b) The P/V-ITS-S requests the C-ITS-S to search for indoor positioning references using the prepared conditions.<br>c) The C-ITS-S searches for indoor positioning references that satisfy the given search conditions.<br>d) The C-ITS-S transfers the search results[Note 3] to the P/V-ITS-S.<br>e) The P/V-ITS-S can select target indoor positioning references among the transferred candidates with the user's confirmation or configurations of implemented indoor navigation. |
| **Note** | 1) Identification of the target indoor space can be conducted through use case cluster "UC 1 — Identification of indoor space".<br>2) Refer to the "`search-indoor-positioning-references`" message in 8.10 for the kinds and types of conditions. Which search conditions are available depends on the implemented service flow. Some values for search conditions can be based on the user's inputs or other data managed during indoor navigation depending on the specific design and implementation.<br>3) Refer to the "`indoorPositioningReferenceInfo`" data type in Annex A for attributes of an indoor positioning reference. |

**Table 6** *(continued)*

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| b) | `search-indoor-positioning-references` | P/V | Sends the prepared conditions for searching for indoor positioning references to the C-ITS-S. | 8.10 |
| d) | `candidates-of-indoor-positioning-references` | C | Sends the search results to the P/V-ITS-S. | 8.11 |
| **Note** | | | | |
| None | | | | |

### 7.2.2.4 UC 2.4 — Retrieving an indoor positioning reference

Table 7 defines the use case handling of how a P/V-ITS-S retrieves an indoor positioning reference required for indoor navigation.

**Table 7 — Definition of UC 2.4 — Retrieving an indoor positioning reference**

| | |
|---|---|
| **Use case cluster** | **2 — Indoor navigation data** |
| **Use case name** | **UC 2.4 — Retrieving an indoor positioning reference** |
| **Description** | A P/V-ITS-S retrieves an indoor positioning reference as needed in preparation or execution of indoor navigation through a C-ITS-S. |
| **Pre-condition** | a) Bi-directional communication between a P/V-ITS-S and a C-ITS-S should be available.<br>b) The P/V-ITS-S should have appropriate permission to access the C-ITS-S.<br>c) The target indoor positioning reference to be retrieved should be identified beforehand[Note 1]. |
| **Processing flows** | a) The P/V-ITS-S prepares conditions to retrieve an indoor positioning reference required during indoor navigation.<br>b) The P/V-ITS-S requests the C-ITS-S to retrieve the target indoor positioning reference using the prepared conditions.<br>c) The C-ITS-S prepares and transfers the requested indoor positioning reference to the P/V-ITS-S.<br>d) The C-ITS-S transfers the requested indoor positioning reference[Note 2] to the P/V-ITS-S. |
| **Note** | 1) Identification of the target indoor positioning reference can be conducted using use case "UC 2.3 — Searching for indoor positioning references".<br>2) Detailed format and specifications of an indoor map are defined in ISO 17438-3 as mentioned in Annex D. |

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| b) | `retrieve-indoor-positioning-reference` | P/V | Sends the prepared conditions for retrieving an indoor positioning reference to the C-ITS-S. | 8.12 |
| d) | `indoor-positioning-reference` | C | Sends the target indoor positioning reference to the P/V-ITS-S. | 8.13 |
| **Note** | | | | |
| None | | | | |

### 7.2.3 UC cluster 3 — Client based indoor navigation

This use-case cluster involves use cases that handle situations in which route guidance through indoor navigation is provided at the P/V-ITS-S itself.

#### 7.2.3.1 UC 3.1 — Setting waypoints at a P/V-ITS-S

Table 8 defines the use case in which a P/V-ITS-S sets waypoints, including source and destination points, based on the user's inputs by itself without interactions with a C-ITS-S; this use case is available when a P/V-ITS-S has sufficient data to set waypoints for indoor navigation.

**Table 8 — Definition of UC 3.1 — Setting waypoints at a P/V-ITS-S**

| **Use case cluster** | **3 — Client based indoor navigation** | | | |
|---|---|---|---|---|
| **Use case name** | **UC 3.1 — Setting waypoints at a P/V-ITS-S** | | | |
| **Description** | A P/V-ITS-S sets waypoints, including the source and destination, to plan routes. | | | |
| **Pre-condition** | a) The P/V-ITS-S should have sufficient data to set waypoints, including the source and destination. Basically, the data involves POIs and indoor POI maps for waypoints[Note 1]. | | | |
| **Processing flows** | a) The P/V-ITS-S searches for and sets waypoints using given inputs from the user and data in its possession. | | | |
| **Note** | 1) Indoor POIs or POI maps required for setting waypoints can be acquired, depending on the specific implementation, in some of the following ways.<br>— "UC 1 — Identification of indoor spaces"<br>— "UC 2.1 — Searching for indoor maps"<br>— "UC 2.2 — Retrieving indoor maps"<br>Depending on the implementation, an indoor POI map might be one specific type of indoor map. Refer to ISO 17438-2. | | | |
| **Related flows** | **Message name** | **Exe** | **Message description** | **Message definition** |
| Not applicable | | | | |
| **Note** | | | | |
| None | | | | |

#### 7.2.3.2 UC 3.2 — Route planning at a P/V-ITS-S

Table 9 defines the use case applicable when an indoor navigation application at a P/V-ITS-S plans routes for indoor navigation.

**Table 9 — Definition of UC 3.2 — Route planning at a P/V-ITS-S**

| **Use case cluster** | **3 — Client based indoor navigation** |
|---|---|
| **Use case name** | **UC 3.2 — Route planning at a P/V-ITS-S** |
| **Description** | A P/V-ITS-S plans routes for guidance by itself[Note 1]. |
| **Pre-condition** | a) The P/V-ITS-S needs to have sufficient data to plan possible routes. Basically, the data for route planning involves various types of indoor maps[Note 2]. |
| **Processing flows** | a) The P/V-ITS-S plans routes using waypoints configured previously, inputs given by the user, and indoor maps in its possession[Note 3]. |

**Table 9** *(continued)*

| | |
|---|---|
| **Note** | 1) A variety of routing algorithms for guidance on planning possible routes can be used according to implementation and available indoor maps required by the routing algorithms.<br>2) Various types of indoor maps, including indoor network maps, for route planning can be acquired through some of the following use cases, depending on specific implementation.<br>— "UC 1 — Identification of indoor spaces"<br>— "UC 2.1 — Searching for indoor maps"<br>— "UC 2.2 — Retrieving indoor maps"<br>For detailed specification, refer to ISO 17438-2.<br>3) Several routing options, for example, routes for disabilities or wheel-chairs, are possible depending on the types and formats of indoor maps, especially indoor network maps. Refer to ISO 17438-2. |

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| Not applicable. | | | | |
| **Note** | | | | |
| None | | | | |

### 7.2.3.3 UC 3.3 — Route guidance at a P/V-ITS-S

Table 10 defines the use case applicable when a planned route is guided by a P/V-ITS-S.

**Table 10 — Definition of UC 3.3 — Route guidance at a P/V-ITS-S**

| | |
|---|---|
| **Use case cluster** | **3 — Client based indoor navigation** |
| **Use case name** | **UC 3.3 — Route guidance at a P/V-ITS-S** |
| **Description** | A P/V-ITS-S provides route guidance[Note 1]. |
| **Pre-condition** | a) The P/V-ITS-S needs to have sufficient data to execute route guidance by itself. According to the specific implementation of indoor navigation, various types of indoor navigation data may be required[Note 2]. |
| **Processing flows** | a) A user starts indoor navigation, that is, the P/V-ITS-S starts to provide guidance messages to the user after setting waypoints, including the source and destination.<br>b) The P/V-ITS-S provides guidance messages according to the user's movement[Note 3].<br>c) When the user reaches the destination, the indoor navigation is terminated. |
| **Note** | 1) A variety of implementations for route guidance are possible.<br>2) Depending on the detailed scenario and implementation of the route guidance, various indoor maps and indoor positioning references are necessary during indoor navigation. In that case, some of following use cases can be referred to obtain relevant indoor navigation data.<br>— "UC 1 — Indentification of indoor space"<br>— "UC 2 — Search and retrieval of indoor navigation data"<br>3) If the planned route needs to be changed, for example, the user's movement is out of the pre-planned routes, the overall processing flows for re-planning routes can be repeated internally. |

**Table 10** *(continued)*

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| Not applicable | | | | |
| **Note** | | | | |
| None | | | | |

### 7.2.4 UC cluster 4 — Server based indoor navigation

This use-case cluster involves use cases that handle situations in which route guidance through indoor navigation is provided by the C-ITS-S.

#### 7.2.4.1 UC 4.1 — Setting waypoints by a C-ITS-S

Table 11 defines the use case when a P/V-ITS-S sets waypoints, including source and destination points, through interactions with a C-ITS-S, i.e. this use case is available when a P/V-ITS-S does not have sufficient data to set waypoints for indoor navigation, but the C-ITS-S has.

**Table 11 — Definition of UC 4.1 — Setting waypoints by a C-ITS-S**

| | |
|---|---|
| **Use case cluster** | **4 — Server based indoor navigation** |
| **Use case name** | **UC 4.1 — Setting waypoints by a C-ITS-S** |
| **Description** | A P/V-ITS-S sets waypoints, including source and destination, to plan routes through interactions with a C-ITS-S. |
| **Pre-condition** | a) The P/V-ITS-S does not have sufficient indoor POIs to set waypoints, but the C-ITS-S has indoor POIs that can be used as waypoints.<br>b) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>c) The P/V-ITS-S should have appropriate permission to access the C-ITS-S. |
| **Processing flows** | a) The user inputs information to search for an indoor POI as a waypoint at a P/V-ITSI-S. The information might include the name, category, and address of the POI.<br>b) The P/V-ITS-S requests the C-ITS-S to search for an indoor POI using the given information[Note 1].<br>c) The C-ITS-S searches for candidates of indoor POIs that satisfy the given search conditions.<br>d) The C-ITS-S transfers the search results to the P/V-ITS-S[Note 2].<br>e) The P/V-ITS-S selects POIs among the transferred candidates of POIs based on the user's confirmation.<br>f) The P/V-ITS-S repeats a) to e) to complete a list of waypoints, including the source and destination. |
| **Note** | 1) Refer to the "`search-indoor-POIs`" message in 8.2<br>2) Refer to the "`candidates-of-indoor-POIs`" message in 8.3 |

**Table 11** *(continued)*

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| Not applicable | | | | |
| **Note** | | | | |
| None | | | | |

### 7.2.4.2 UC 4.2 — Route planning C-ITS-S

Table 12 defines the use case applicable when an indoor navigation application at a P/V-ITS-S plans routes for indoor navigation interacting with a C-ITS-S, i.e. this use case is available if the P/V-ITS-S does not have sufficient data to plan routes for indoor navigation, but the C-ITS-S does.

**Table 12 — Definition of UC 4.2 — Route planning by a C-ITS-S**

| | |
|---|---|
| **Use case cluster** | **4 — Server based indoor navigation** |
| **Use case name** | **UC 4.2 — Route planning by a C-ITS-S** |
| **Description** | A P/V-ITS-S plans routes interacting with a C-ITS-S. |
| **Pre-condition** | a) The P/V-ITS-S does not have sufficient data, including indoor networks, to plan routes.<br>b) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>c) The P/V-ITS-S should have appropriate permission to access the C-ITS-S.<br>e) Waypoints, including the source and destination to be visited in the planned routes, should be identified previously[Note 1]. |
| **Processing flows** | a) The P/V-ITS-S prepares the list of waypoints to be visited in routes to be planned.<br>b) The P/V-ITS-S requests the C-ITS-S to plan routes using the prepared waypoints.<br>c) The C-ITS-S plans routes that visit the given waypoints[Note 2].<br>d) The C-ITS-S transfers candidates of the planned routes to the P/V-ITS-S[Note 3].<br>e) The P/V-ITS-S determines a planned route based on the user's selection and confirmation. |
| **Note** | 1) Refer to use cases "UC 5.1 — Setting waypoints by a C-ITS-S".<br>2) Several routing options, for example, routes for people with disabilities or wheel-chairs, are possible depending on the types and formats of the indoor maps, especially indoor network maps. Refer to ISO 17438-2.<br>3) The detailed description of planned routes depends on implementation of route planning and guidance in a specific indoor navigation plan. For example, an implementation type of server-based indoor navigation can send all planned routes as they are to the P/V-ITS-S, including detailed routes and options, and another type can send only notification of completion of planned routes to the P/V-ITS-S depending on the capabilities and resources available. This is in the scope of "server-based navigation", not "indoor navigation". |

| Related flows | Message name | Exe | Description | Message definition |
|---|---|---|---|---|
| Not applicable | | | | |
| **Note** | | | | |
| None | | | | |

#### 7.2.4.3 UC 4.3 — Route guidance for a C-ITS-S

Table 13 defines the use case applicable when a P/V-ITS-S receives guidance for a planned route from a C-ITS-S.

**Table 13 — Definition of UC 4.3 — Route guidance by a C-ITS-S**

| | |
|---|---|
| **Use case cluster** | **4 — Server based indoor navigation** |
| **Use case name** | **UC 4.3 — Route guidance by a C-ITS-S** |
| **Description** | A P/V-ITS-S is guided by a C-ITS-S for indoor navigation. |
| **Pre-condition** | a) The P/V-ITS-S does not have sufficient data for route guidance. Data required for route guidance, for example, guidance messages, are provided by the C-ITS-S.<br>b) Bi-directional communication between the P/V-ITS-S and the C-ITS-S should be available.<br>c) The P/V-ITS-S should have appropriate permission to access the C-ITS-S.<br>d) A planned and confirmed route should exist at the C-ITS-S. |
| **Processing flows** | a) The P/V-ITS-S requests the C-ITS-S to start an indoor navigation session with information about the planned route, for example, the identifier of the planned route[Note 1].<br>b) The C-ITS-S initializes server based indoor navigation. Optionally, the C-ITS-S can send a guidance message to the P/V-ITS-S depending on specific implementation.<br>c) The P/V-ITS-S receives notification from the C-ITS-S that indoor navigation has begun.<br>d) The P/V-ITS-S takes one of the following actions during the indoor navigation.<br>1) Moves to the next location and determines and sends the current location[Note 2].<br>2) If the current indoor navigation needs to be cancelled, the P/V-ITS-S sends a message to cancel the current indoor navigation[Note 3].<br>e) The C-ITS-S receives the updated location from the P/V-ITS-S and provides the next guidance message after some internal processing.<br>f) According to the result of the internal processing, the C-ITS-S takes one of the following actions[Note 6].<br>1) The C-ITS-S can send a guidance message or an error message to the P/V-ITS-S for the next guidance message.<br>2) If the P/V-ITS-S does not follow the current planned route, the C-ITS-S can re-plan new routes and transfer the newly planned routes or information to the P/V-ITS-S.<br>3) The C-ITS-S can cancel the navigation based on the request from the P/V-ITS-S.<br>4) If the P/V-ITS-S reaches the destination, the C-ITS-S notifies the P/V-ITS-S that the user has reached the destination.<br>g) Repeats d)–f). |
| **Note** | 1) Refer to use cases “UC 5.2 — Route planning by a C-ITS-S”.<br>2) Refer to use cases “UC 3 — Indoor positioning”. Depending on a specific implementation of server-based indoor navigation, transfer of a current location of a P/V-ITS-S can be realized in the form of the determined location or parameter values to execute indoor positioning at the C-ITS-S.<br>3) Various definitions of messages related to flows of server-based navigation, for example, cancellation, pause, etc., are possible depending on the specific implementation. Definitions of such guidance messages for server-based indoor navigation is not in the scope of this document. |

**Table 13** *(continued)*

| Related flows | Message name | Exe | Message description | Message definition |
|---|---|---|---|---|
| Not applicable | | | | |
| **Note** | | | | |
| None | | | | |

# 8 Message definitions

## 8.1 Overview

This clause defines messages used in definitions of use cases in Clause 7. The definitions in this clause show the structure and composition of each message. The descriptions of structure and composition include the name, data type, mandatory or optional and maximum number of occurrences in each field in the message.

Specific encoding of each message can use several forms. For example, encodings using XML or DXM (Data eXchange Message) using ASN.1 are possible. How to encode messages using VIDF and DXM configurations, using ASN.1, which is defined in ISO 13184-2 is given with definitions of the messages and data types in this clause, Annex A and Annex B. Detailed example schemas and encoding using XML are also given with their definitions in this document.

Figure 2 below shows a sketch of the message flow and each message is defined with a description in the following sub-clauses. The implementation of the message flow defined in this document meets the requirements and the conditions on the base communication architecture and the environments as specified in ISO 17429 and ISO 17423.

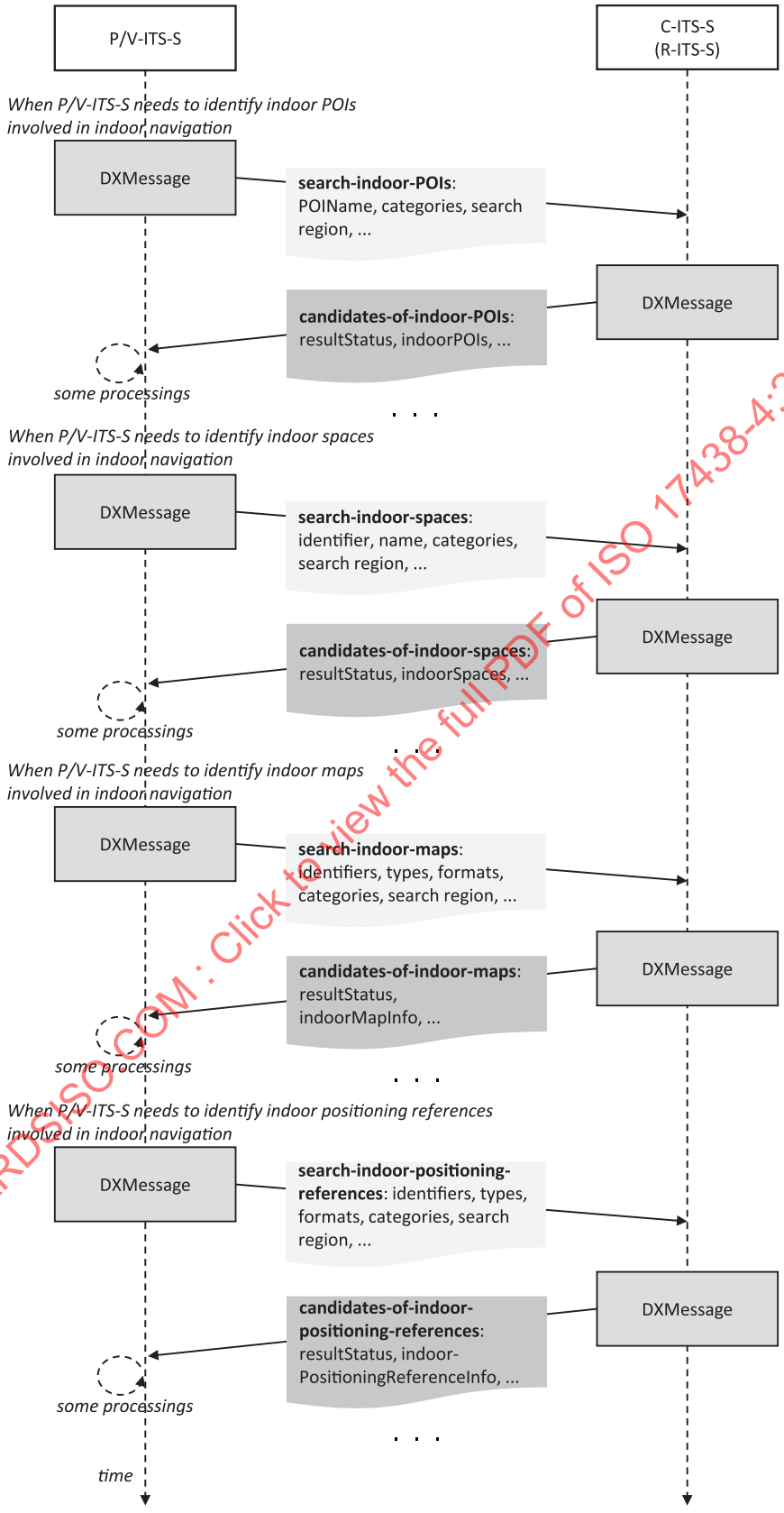


**Figure 2 — Message flow**

## 8.2 search-indoor-POIs

Table 14 defines the "search-indoor-POIs" message used when a P/V-ITS-S sends conditions to search for indoor POIs to be used for setting a waypoint.

**Table 14 — Definition of search-indoor-POIs**

| Message | Name | search-indoor-POIs | | |
|---|---|---|---|---|
| | Executor | P/V-ITS-S | | |
| | Description | Send conditions used to search for indoor POIs involved in indoor navigation to the C-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| Address | string | C[a] | 1 | Address of indoor POIs. |
| POIName | string | C[a] | 1 | Name of the POI. |
| POICategories | string | C[a] | 2 | Categories belonging to indoor POIs to be searched for. |
| includedIn | SearchRegion | C[a] | 1 | Region which includes locations of POIs to be searched for (see SearchRegion date type in Annex A). |
| spaceIdentifier | string | C[a] | 1 | Identifier[b] of an indoor space belonging to indoor POIs to be searched for. |
| **Note** | | | | |
| [a] One or more fields should be given. If several fields are given, each field acts as an "AND" condition. | | | | |
| [b] How to construct an identifier of an indoor space, i.e. the composition of an indoor space identifier, is out of the scope of this document. | | | | |
| * For more explanations on each field, refer to IndoorPOI data type in Annex A. | | | | |
| **DXM Config** | | | | |

```
msg {
   { iTSmsID 1000, name { textId 22000, longname "search-indoor-POIs" },
      type info, executer '1100'B, dataParamList { 113, 110, 115, 116, 136, 100 }
}
```

**Table 14** *(continued)*

**VIDF Config**

```
dataParam {
   { rvId 100, name { textId 21000, longname "identifier of an indoor space" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 110, name { textId 21010, longname "name of an indoor POI" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 113, name { textId 21013, longname "address of an indoor POI" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 115, name { textId 21015, longname "first category of an indoor POI" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 116, name { textId 21016, longname "second category of an indoor POI" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 136, name { textId 21036, longname "a search region" },
      dataTypeId 112, accessType '10000'B, dataParamProperty collection },
   ...
}, dataType {
   { dataTypeId 100, type string: { } },
   ...
   -- refere Annex A.3 for dataTypeId 112 --
   ...
}
```

**XML schema example**

```
<xs:element name="search-indoor-POIs" type="search-indoor-POIs"/>
<xs:complexType name="search-indoor-POIs">
   <xs:sequence>
      <xs:element name="address" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:element name="POIName" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:element name="POICategories" type="xs:string" minOccurs="0"
                  maxOccurs="2"/>
      <xs:element name="includedIn" type="xs:string" minOccurs="1"
                  maxOccurs="1"/>
      <xs:element name="spaceIdentifier" type="xs:string" minOccurs="1"
                  maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```



## 8.3 candidates-of-indoor-POIs

Table 15 defines the "`candidates-of-indoor-POIs`" message that is used when a C-ITS-S sends the searched for POIs to the P/V-ITS-S as a response to a search-indoor-POIs message.

**Table 15 — Definition of candidates-of-indoor-POIs**

| Message | Name | candidates-of-indoor-POIs | | |
|---|---|---|---|---|
| | Executor | C-ITS-S | | |
| | Description | Send the found indoor POIs to the P/V-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| `resultStatus` | `ResultStatus` | M | 1 | Result code (see `ResultStatus` code list in Annex B). |
| `indoorPOIs` | `IndoorPOI` | C[a] | N | Searched for indoor POIs (see `IndoorPOI` date type in Annex A). |
| **Note** | | | | |
| [a] This field should be given if `resultStatus` is SUCCESS and there are indoor POIs. | | | | |

**DXM Config**

```
msg {
   { iTSmsID 1001, name { textId 22001, longname "candidates-of-indoor-POIs" },
      type info, executer '0001'B, dataParamList { 209, 122 } }
}
```

**VIDF Config**

```
dataParam {
   ...
   { rvId 122, name { textId 21022, longname "a set of indoor POIs" },
      dataTypeId 105, accessType '10000'B, dataParamProperty collection },
   { rvId 209, name { textId 21109, longname "result a processing" },
      dataTypeId 128, accessType '10000'B, dataParamProperty other },
}, dataType {
   ...
   -- refere Annex A.2 for dataTypeId 104 --
   { dataTypeId 105, name { textId 20004, longname "a set of indoor POIs" },
      type array: 104 },
   -- refere Annex B.1 for dataTypeId 128 --
   ...
}
```

**XML schema example**

```
<xs:element name="candidates-of-indoor-POIs" type="candidates-of-indoor-POIs"/>
<xs:complexType name="candidates-of-indoor-POIs">
   <xs:sequence>
      <xs:element name="resultStatus" type="xs:string" minOccurs="1"
                  maxOccurs="1"/>
      <xs:element name="indoorPOIs" type="xs:string" minOccurs="0"
                  maxOccurs="unbounded"/>
   </xs:sequence>
</xs:complexType>
```

## 8.4 search-indoor-spaces

Table 16 defines the "search-indoor-spaces" message that is used when a P/V-ITS-S sends conditions to search indoor spaces involved in indoor navigation to a C-ITS-S.

**Table 16 — Definition of search-indoor-spaces**

| Message | Name | search-indoor-spaces | | |
|---|---|---|---|---|
| | Executor | P/V-ITS-S | | |
| | Description | Send conditions used to search for indoor spaces involved in indoor navigation to a C-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| identifier | string | C[a] | N | Identifiers[b] of indoor spaces to be searched for. |
| name | string | C[a] | N | Names of indoor spaces to be searched for. |
| address | string | C[a] | N | Addresses of indoor spaces to be searched for. |
| categories | string | C[a] | 2 | Categories belonging to indoor spaces to be searched for. |
| overlappedWith | SearchRegion | C[a] | 1 | Region which overlaps with boundaries of indoor spaces to be searched for (see Annex A SearchRegion data type). |
| **Note** | | | | |
| [a] One or more fields should be given. If several fields are given, each field acts as an "AND" condition. | | | | |
| [b] How to construct an identifier of an indoor space, i.e. the composition of an indoor space identifier is out of the scope of this document. | | | | |
| * For more explanations on each field, refer to IndoorSpace data type in Annex A. | | | | |
| **DXM Config** | | | | |

```
msg {
   { iTSmsID 1002, name { textId 22002, longname "search-indoor-spaces" },
      type info, executer '1100'B, dataParamList { 138, 141, 144, 150, 151, 136 }
}
```

**Table 16** *(continued)*

| VIDF Config |
|---|

```
dataParam {
   ...
   { rvId 136, name { textId 21036, longname "a search region" },
      dataTypeId 112, accessType '10000'B, dataParamProperty collection },
   { rvId 138, name { textId 21038,
                      longname "a set of identifiers of indoor spaces" },
      dataTypeId 103, accessType '10000'B, dataParamProperty collection },
   { rvId 141, name { textId 21041, longname "a set of names of indoor spaces" },
      dataTypeId 103, accessType '10000'B, dataParamProperty collection },
   { rvId 144, name { textId 21044,
                      longname "a set of addresses of indoor spaces" },
      dataTypeId 103, accessType '10000'B, dataParamProperty collection },
   { rvId 150, name { textId 21050,
                      longname "first category of an indoor space" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 151, name { textId 21051,
                      longname "second category of an indoor space" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   ...
}, dataType {
   { dataTypeId 100, type string: { } },
   { dataTypeId 103, name { textId 20002, longname "set of strings" },
      type array: 100 },
   ...
   -- refere Annex A.3 for dataTypeId 112 --
   ...
}
```

**Table 16** *(continued)*

| XML schema example |
|---|
| <xs:element name="search-indoor-spaces" type="search-indoor-spaces"/><br><xs:complexType name="search-indoor-spaces"><br><xs:sequence><br><xs:element name="identifier" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br><xs:element name="name" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br><xs:element name="address" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br><xs:element name="categories" type="xs:string" minOccurs="0"<br>maxOccurs="2"/><br><xs:element name="overlappedWith" type="xs:string" minOccurs="0"<br>maxOccurs="1"/><br></xs:sequence><br></xs:complexType> |

## 8.5 candidates-of-indoor-spaces

Table 17 defines the "candidates-of-indoor-spaces" message that is used when a C-ITS-S sends searched for indoor spaces as a response to a search-indoor-spaces message to the P/V-ITS-S.

**Table 17 — Definition of candidates-of-indoor-spaces**

| Message | Name | candidates-of-indoor-spaces | | |
|---|---|---|---|---|
| | Executor | C-ITS-S | | |
| | Description | Send information about the searched for candidates of indoor spaces to the P/V-ITS-S. | | |
| Parameters | | | | |
| Name | Type | M/O | MO | Description |
| resultStatus | ResultStatus | M | 1 | Result code (see ResultStatus code list in Annex B). |
| indoorSpaces | IndoorSpace | C[a] | N | List of searched for indoor spaces (see IndoorSpace data type in Annex A). |
| Note | | | | |
| [a] This field should be given if resultStatus is SUCCESS and there are indoor spaces. | | | | |
| DXM Config | | | | |
| msg {<br>{ iTSmsID 1003, name { textId 22003, longname "candidates-of-indoor-spaces" },<br>type info, executer '0001'B, dataParamList { 209, 162 }<br>} | | | | |

**Table 17** *(continued)*

| VIDF Config |
|---|
| dataParam {<br>...<br>{ rvId 162, name { textId 21062, longname "a set of indoor spaces" },<br>dataTypeId 120, accessType '10000'B, dataParamProperty collection },<br>{ rvId 209, name { textId 21109, longname "result a processing" },<br>dataTypeId 128, accessType '10000'B, dataParamProperty other },<br>}, dataType {<br>...<br>-- refere Annex A.7 for dataTypeId 119 --<br>{ dataTypeId 120, name { textId 20019,<br>longname "a set of information about indoor spaces" },<br>type array: 119 },<br>-- refere Annex B.1 for dataTypeId 128 --<br>...<br>} |
| **XML schema example** |
| <xs:element name="candidates-of-indoor-spaces" type="candidates-of-indoor-spaces"/><br><xs:complexType name="candidates-of-indoor-spaces"><br><xs:sequence><br><xs:element name="resultStatus" type="xs:string" minOccurs="1"<br>maxOccurs="1"/><br><xs:element name="indoorSpace" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br></xs:sequence><br></xs:complexType> |

## 8.6 search-indoor-maps

Table 18 defines the "search-indoor-maps" message that is used when a P/V-ITS-S sends conditions to search for indoor maps to be used in indoor navigation to a C-ITS-S.

**Table 18 — Definition of search-indoor-maps**

| Message | Name | search-indoor-maps | | |
|---|---|---|---|---|
| | Executor | P/V-ITS-S | | |
| | Description | Sends conditions used to search for indoor maps involved in indoor navigation to C-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| `spaceIdentifier` | `string` | C[a] | 1 | Identifier[c] of an indoor space in which indoor maps need to be searched for. |
| `mapIdentifier` | `string` | C[a] | N | Identifiers[c] of indoor maps to be searched for. |
| `mapTypes` | `IndoorMapType` | C[b] | N | Types of indoor maps processable in a P/V-ITS-S (see `IndoorMapType` code list in Annex B). |
| `mapFormats` | `string` | C[b] | N | Formats of indoor maps processable in a P/V-ITS-S. |
| `mapCategories` | `string` | C[b] | 2 | Categories belonging to indoor maps to be searched for. |
| `overlappedWith` | `SearchRegion` | C[b] | 1 | Region which overlaps with boundaries of indoor maps to be searched for. |
| **Note** | | | | |
| [a] One or more fields should be given. | | | | |
| [b] If several fields are given, each field acts as an "AND" condition for searching for indoor maps. | | | | |
| [c] How to construct an identifier of an indoor map or indoor space, i.e. the composition of an identifier is out of the scope of this document. | | | | |
| **DXM Config** | | | | |

```
msg {
   { iTSmsID 1004, name { textId 22004, longname "search-indoor-maps" },
     type info, executer '1100'B, dataParamList { 100, 156, 155, 175, 167,
168, 136 }
}
```

**Table 18** *(continued)*

| VIDF Config |
|---|
| dataParam {<br>{ rvId 100, name { textId 21000, longname "identifier of an indoor space" },<br>dataTypeId 100, accessType '10000'B, dataParamProperty other },<br>{ rvId 136, name { textId 21036, longname "a search region" },<br>dataTypeId 112, accessType '10000'B, dataParamProperty collection },<br>{ rvId 155, name { textId 21055,<br>longname "available indoor map types in an indoor space" },<br>dataTypeId 114, accessType '10000'B, dataParamProperty collection },<br>{ rvId 156, name { textId 21056,<br>longname "identifiers of available indoor maps in an indoor space" },<br>dataTypeId 103, accessType '10000'B, dataParamProperty collection },<br>{ rvId 167, name { textId 21067, longname "first category of an indoor map" },<br>dataTypeId 100, accessType '10000'B, dataParamProperty other },<br>{ rvId 168, name { textId 21068, longname "second category of an indoor map" },<br>dataTypeId 100, accessType '10000'B, dataParamProperty other },<br>{ rvId 175, name { textId 21075, longname "a set of formats of indoor maps" },<br>dataTypeId 103, accessType '10000'B, dataParamProperty collection },<br>...<br>}, dataType {<br>{ dataTypeId 100, type string: { } },<br>{ dataTypeId 103, name { textId 20002, longname "set of strings" },<br>type array: 100 },<br>...<br>-- refere Annex A.3 for dataTypeId 112 --<br>-- refere Annex B.3 for dataTypeId 113 --<br>{ dataTypeId 114, name { textId 20013, longname "a set of types of indoor maps" },<br>type array: 113 },<br>...<br>} |

**Table 18** *(continued)*

| XML schema example |
|---|
| <xs:element name="search-indoor-maps" type="search-indoor-maps"/><br><xs:complexType name="search-indoor-maps"><br><xs:sequence><br><xs:element name="spaceIdentifier" type="xs:string" minOccurs="0" maxOccurs="1"/><br><xs:element name="mapIdentifier" type="xs:string" minOccurs="0" maxOccurs="unbounded"/><br><xs:element name="mapTypes" type="xs:string" minOccurs="0" maxOccurs="unbounded"/><br><xs:element name="mapFormats" type="xs:string" minOccurs="0" maxOccurs="unbounded"/><br><xs:element name="mapCategories" type="xs:string" minOccurs="0" maxOccurs="2"/><br><xs:element name="overlappedWith" type="xs:string" minOccurs="0" maxOccurs="1"/><br></xs:sequence><br></xs:complexType> |

## 8.7 candidates-of-indoor-maps

Table 19 defines the "candidates-of-indoor-maps" message used when a C-ITS-S sends information about found indoor maps as a response to a search-indoor-maps message to the P/V-ITS-S.

**Table 19 — Definition of candidates-of-indoor-maps**

| Message | Name | candidates-of-indoor-maps | | |
|---|---|---|---|---|
| | Executor | C-ITS-S | | |
| | Description | Send information about the search candidates of indoor maps to the P/V-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| resultStatus | ResultStatus | M | 1 | Result code (see ResultStatus code list in Annex B). |
| indoorMaps | IndoorMapInfo | C[a] | N | Information about searched for indoor maps (see IndoorMapInfo data type in Annex A). |
| **Note** | | | | |
| [a] This field should be given if resultStatus is SUCCESS and there are indoor maps. | | | | |
| **DXM Config** | | | | |
| msg {<br>{ iTSmsID 1005, name { textId 22005, longname " candidates-of-indoor-maps" },<br>type info, executer '0001'B, dataParamList { 209, 183 }<br>} | | | | |

**Table 19** *(continued)*

| VIDF Config |
|---|
| dataParam {<br>...<br>{ rvId 183, name { textId 21083,<br>longname "a set of information about an indoor map" },<br>dataTypeId 122, accessType '10000'B, dataParamProperty collection },<br>{ rvId 209, name { textId 21109, longname "result a processing" },<br>dataTypeId 128, accessType '10000'B, dataParamProperty other },<br>}, dataType {<br>...<br>-- refere Annex A.8 for dataTypeId 121 --<br>{ dataTypeId 122, name { textId 20021,<br>longname "a set of information about indoor maps" },<br>type array: 121 },<br>-- refere Annex B.1 for dataTypeId 128 --<br>...<br>} |
| **XML schema example** |
| <xs:element name="candidates-of-indoor-maps" type="candidates-of-indoor-maps"/><br><xs:complexType name="candidates-of-indoor-maps"><br><xs:sequence><br><xs:element name="resultStatus" type="xs:string" minOccurs="1"<br>maxOccurs="1"/><br><xs:element name="indoorMaps" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br></xs:sequence><br></xs:complexType> |

## 8.8 retrieve-indoor-map

Table 20 defines the "retrieve-indoor-map" message that is used when a P/V-ITS-S needs to retrieve an indoor map to be used in indoor navigation from the C-ITS-S.

**Table 20 — Definition of retrieve-indoor-map**

| Message | Name | retrieve-indoor-map | | |
|---|---|---|---|---|
| | Executor | P/V-ITS-S | | |
| | Description | Send a request to retrieve a specific indoor map to the C-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| identifier | string | M | 1 | Identifier[a] of an indoor map to be retrieved. |
| **Note** | | | | |
| [a] How to construct an identifier of an indoor map is out of scope. | | | | |

**Table 20** *(continued)*

| DXM Config |
|---|
| msg {<br>{ iTSmsID 1006, name { textId 22006, longname "retrieve-indoor-map" },<br>type info, executer '1100'B, dataParamList { 156 }<br>} |
| **VIDF Config** |
| dataParam {<br>...<br>{ rvId 156, name { textId 21056,<br>longname "identifiers of available indoor maps in an indoor space" },<br>dataTypeId 103, accessType '10000'B, dataParamProperty collection },<br>...<br>}, dataType {<br>{ dataTypeId 100, type string: { } },<br>{ dataTypeId 103, name { textId 20002, longname "set of strings" },<br>type array: 100 },<br>...<br>} |
| **XML schema example** |
| <xs:element name="retrieve-indoor-map" type="retrieve-indoor-map"/><br><xs:complexType name="retrieve-indoor-map"><br><xs:sequence><br><xs:element name="identifier" type="xs:string" minOccurs="1" maxOccurs="1"/><br></xs:sequence><br></xs:complexType> |

## 8.9 indoor-map

Table 21 defines the "indoor-map" message that is used when the C-ITS-S sends the requested indoor map to the P/V-ITS-S as a response to the "retrieve-indoor-map" message.

**Table 21 — Definition of indoor-map**

| Message | Name | indoor-map | | |
|---|---|---|---|---|
| | Executor | C-ITS-S | | |
| | Description | Send the requested indoor maps to the P/V-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| resultStatus | ResultStatus | M | 1 | Result code (see ResultStatus code list in Annex B). |
| size | Integer | C[a] | 1 | Size of the requested indoor map[b]. |
| map | Binary | C[a] | 1 | Indoor map content itself. |
| **Note** | | | | |

**Table 21** *(continued)*

[a] This field should be given if `resultStatus` is `SUCCESS` and there is the indoor map.

[b] Size in bytes.

**DXM Config**

```
msg {
   { iTSmsID 1007, name { textId 22007, longname "indoor-map" },
      type info, executer '0001'B, dataParamList { 209, 176, 184 }
}
```

**VIDF Config**

```
dataParam {
   ...
   { rvId 176, name { textId 21076, longname "size of an indoor map" },
      dataTypeId 107, accessType '10000'B, dataParamProperty other },
   { rvId 184, name { textId 21084, longname "content of indoor map" },
      dataTypeId 125, accessType '10000'B, dataParamProperty other },
   { rvId 209, name { textId 21109, longname "result a processing" },
      dataTypeId 128, accessType '10000'B, dataParamProperty other }
}, dataType {
   ...
   { dataTypeId 107, name { textId 20006, longname "distance in meters" },
      type numeric: { decimalPlaces 0, unitId 0, factor 1, quotient 1,
       addend 0 } },
   { dataTypeId 125, name { textId 20024,
         longname "binary data of an indoor map or an indoor positioning
reference" },
      type octet: 0 },
   -- refere Annex B.1 for dataTypeId 128 --
   ...
}
```

**XML schema example**

```
<xs:element name="indoor-map" type="indoor-map"/>
<xs:complexType name="indoor-map">
   <xs:sequence>
      <xs:element name="resultStatus" type="xs:string" minOccurs="1"
                  maxOccurs="1"/>
      <xs:element name="size" type="xs:integer" minOccurs="0" maxOccurs="1"/>
      <xs:element name="map" type="xs:string" minOccurs="0" maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```

## 8.10 search-indoor-positioning-references

Table 22 defines the "search-indoor-positioning-references" message that is used when a P/V-ITS-S sends to the C-ITS-S the conditions to search for indoor positioning reference data to be used to determine locations in indoor navigation.

**Table 22 — Definition of search-indoor-positioning-references**

| Message | Name | search-indoor-positioning-reference-data | | |
|---|---|---|---|---|
| | Executor | P/V-ITS-S | | |
| | Description | Send conditions used to search for indoor positioning reference data involved in indoor navigation to C-ITS-S. | | |
| Parameters | | | | |
| Name | Type | M/O | MO | Description |
| spaceIdentifier | string | C[a] | 1 | Identifier of an indoor space in which indoor positioning reference data need to be searched for. |
| referenceIdentifier | string | C[a] | N | Identifiers[c] of indoor positioning references to be searched for. |
| referenceTypes | IndoorPositioningReferenceType | C[b] | N | Types of indoor positioning references processable in the P/V-ITS-S (see IndoorPositioningReferenceType code list in Annex B). |
| referenceFormats | string | C[b] | N | Formats of indoor positioning references processable in the P/V-ITS-S. |
| referenceCategories | string | C[b] | 2 | Categories belonging to indoor positioning references that need to be searched for. |
| overlappedWith | SearchRegion | C[b] | 1 | Region which overlaps with boundaries of indoor positioning references to be searched for. |
| Note | | | | |
| [a] one or more fields should be given. | | | | |
| [b] If several fields are given, each field acts as an "AND" condition for searching for indoor positioning references. | | | | |
| [c] How to construct an identifier of an indoor reference is out of the scope of this document. | | | | |
| DXM Config | | | | |

```
msg {
   { iTSmsID 1008, name { textId 22008,
                          longname "search-indoor-positioning-references" },
     type info, executer '1100'B, dataParamList { 100, 160, 159, 197, 189, 190, 136 }
}
```

**Table 22** *(continued)*

| VIDF Config |
|---|

```
dataParam {
   { rvId 100, name { textId 21000, longname "identifier of an indoor space" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 136, name { textId 21036, longname "a search region" },
      dataTypeId 112, accessType '10000'B, dataParamProperty collection },
   { rvId 159, name { textId 21059,
                      longname "available indoor positioning references in an indoor
space" },
      dataTypeId 118, accessType '10000'B, dataParamProperty other },
   { rvId 160, name { textId 21060,
                      longname "identifiers of available indoor positioning reference in
an indoor space" },
      dataTypeId 103, accessType '10000'B, dataParamProperty collection },
   { rvId 189, name { textId 21089,
                      longname "first category of an indoor positioning reference" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 190, name { textId 21090,
                      longname "second category of an indoor positioning reference" },
      dataTypeId 100, accessType '10000'B, dataParamProperty other },
   { rvId 197, name { textId 21097,
                      longname "a set of formats of indoor positioning references" },
      dataTypeId 103, accessType '10000'B, dataParamProperty collection },
   ...
}, dataType {
   { dataTypeId 100, type string: { } },
   { dataTypeId 103, name { textId 20002, longname "set of strings" },
      type array: 100 },
   -- refere Annex A.3 for dataTypeId 112 --
   -- refere Annex B.4 for dataTypeId 117 --
   { dataTypeId 118, name { textId 20017,
                            longname "a set of types of indoor positioning references" },
      type array: 117 },
   ...
}
```

**Table 22** *(continued)*

| XML schema example |
|---|
| <xs:element name="search-indoor-positioning-references"<br>type="search-indoor-positioning-references"/><br><xs:complexType name="search-indoor-positioning-references"><br><xs:sequence><br><xs:element name="spaceIdentifier" type="xs:string" minOccurs="0"<br>maxOccurs="1"/><br><xs:element name="referenceIdentifier" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br><xs:element name="referenceTypes" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br><xs:element name="referenceFormats" type="xs:string" minOccurs="0"<br>maxOccurs="unbounded"/><br><xs:element name="referenceCategories" type="xs:string" minOccurs="0"<br>maxOccurs="2"/><br><xs:element name="overlappedWith" type="xs:string" minOccurs="0"<br>maxOccurs="1"/><br></xs:sequence><br></xs:complexType> |

## 8.11 candidates-of-indoor-positioning-references

Table 23 defines the "candidates-of-indoor-positioning-references" message that is used when the C-ITS-S sends information to the P/V-ITS-S about the found indoor positioning reference data as a response to a "search-indoor-positioning-references" message.

**Table 23 — Definition of candidates-of-indoor-positioning-references**

| Message | Name | candidates-of-indoor-positioning-references | | |
|---|---|---|---|---|
| | Executor | C-ITS-S | | |
| | Description | Send information about the searched for candidates of indoor positioning reference data to the P/V-ITS-S. | | |
| Parameters | | | | |
| Name | Type | M/O | MO | Description |
| resultStatus | ResultStatus | M | 1 | Result code (see ResultStatus code list in Annex B). |
| references | IndoorPositioningReferenceInfo | C[a] | N | Information about searched for indoor positioning reference data (see IndoorPositioningReferenceInfo data type in Annex A). |
| Note | | | | |
| [a] This field should be given if resultStatus is SUCCESS and there are indoor positioning references. | | | | |

**Table 23** *(continued)*

**DXM Config**

```
msg {
   { iTSmsID 1009, name { textId 22009,
                          longname "candidates-of-indoor-positioning-
references " },
      type info, executer '0001'B, dataParamList { 209, 205 }
}
```

**VIDF Config**

```
dataParam {
   ...
   { rvId 205, name { textId 21105,
                longname "a set of information about indoor positioning
references" },
      dataTypeId 124, accessType '10000'B, dataParamProperty collection },
   { rvId 209, name { textId 21109, longname "result a processing" },
      dataTypeId 128, accessType '10000'B, dataParamProperty other }
   ...
}, dataType {
   ...
   -- refere Annex A.9 for dataTypeId 123 --
   { dataTypeId 124, name { textId 20023,
                longname "a set of information about indoor positioning
references" },
      type array: 123 },
   -- refere Annex B.1 for dataTypeId 128 --
   ...
}
```

**XML schema example**

```
<xs:element name="candidates-of-indoor-positioning-references"
                type="candidates-of-indoor-positioning-references"/>
<xs:complexType name="candidates-of-indoor-positioning-references">
   <xs:sequence>
      <xs:element name="resultStatus" type="xs:string" minOccurs="1"
                maxOccurs="1"/>
      <xs:element name="references" type="xs:string" minOccurs="0"
                maxOccurs="unbounded"/>
   </xs:sequence>
</xs:complexType>
```

## 8.12 retrieve-indoor-positioning-reference

Table 24 defines the "`retrieve-indoor-positioning-reference`" message that is used when a P/V-ITS-S need to retrieve indoor reference data to be used to determine locations in indoor navigation from the C-ITS-S.

**Table 24 — Definition of retrieve-indoor-positioning-reference**

| Message | Name | retrieve-indoor-positioning-reference | | |
|---|---|---|---|---|
| | Executor | P/V-ITS-S | | |
| | Description | Send a request to retrieve specific indoor positioning reference data to the C-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| identifier | string | M | 1 | Identifier[a] of indoor positioning reference data to be retrieved. |
| **Note** | | | | |
| [a] How to construct an identifier of an indoor positioning reference is out of the scope of this document. | | | | |

**DXM Config**

```
msg {
   { iTSmsID 1010, name { textId 22010,
                          longname "retrieve-indoor-positioning-reference" },
      type info, executer '1100'B, dataParamList { 160 }
}
```

**VIDF Config**

```
dataParam {
   ...
   { rvId 160, name { textId 21060,
                 longname "identifiers of available indoor positioning reference
in an indoor space" },
      dataTypeId 103, accessType '10000'B, dataParamProperty collection },
   ...
}, dataType {
   { dataTypeId 100, type string: { } },
   { dataTypeId 103, name { textId 20002, longname "set of strings" },
      type array: 100 },
   ...
}
```

**XML schema example**

```
<xs:element name="retrieve-indoor-positioning-reference"
                  type="retrieve-indoor-positioning-reference"/>
<xs:complexType name="retrieve-indoor-positioning-reference">
   <xs:sequence>
      <xs:element name="identifier" type="xs:string" minOccurs="1"
                  maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```

## 8.13 indoor-positioning-reference

Table 25 defines the "indoor-positioning-reference" message that is used when the C-ITS-S sends to the P/V-ITS-S the requested indoor positioning reference data as a response to a "retrieve-indoor-positioning-reference" message.

**Table 25 — Definition of indoor-positioning-reference**

| Message | Name | indoor-positioning-reference | | |
|---|---|---|---|---|
| | Executor | C-ITS-S | | |
| | Description | Send the requested indoor positioning reference data to the P/V-ITS-S. | | |
| **Parameters** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| `resultStatus` | `ResultStatus` | M | 1 | Result code (see `ResultStatus` code list in Annex B). |
| `size` | `Integer` | C[a] | 1 | Size of the requested indoor positioning reference[b]. |
| `reference` | `Binary` | C[a] | 1 | Indoor positioning reference content itself. |
| **Note** | | | | |
| [a] This field should be given if `resultStatus` is `SUCCESS` and there is an indoor map. | | | | |
| [b] Size in bytes. | | | | |
| **DXM Config** | | | | |

```
msg {
   { iTSmsID 1011, name { textId 22011, longname "indoor-positioning-reference" },
      type info, executer '0001'B, dataParamList { 209, 198, 206 }
}
```

**Table 25** *(continued)*

**VIDF Config**

```
dataParam {
   ...
   { rvId 198, name { textId 21098,
                      longname "size of an indoor positioning reference" },
      dataTypeId 107, accessType '10000'B, dataParamProperty other },
   { rvId 206, name { textId 21106,
                      longname "content of indoor positioning reference" },
      dataTypeId 125, accessType '10000'B, dataParamProperty other },
   { rvId 209, name { textId 21109, longname "result a processing" },
      dataTypeId 128, accessType '10000'B, dataParamProperty other }
}, dataType {
   ...
   { dataTypeId 107, name { textId 20006, longname "distance in meters" },
      type numeric: { decimalPlaces 0, unitId 0, factor 1, quotient 1,
      addend 0 } },
   { dataTypeId 125, name { textId 20024,
        longname "binary data of an indoor map or an indoor positioning
reference" },
      type octet: 0 },
   -- refere Annex B.1 for dataTypeId 128 --
   ...
}
```

**XML schema example**

```
<xs:element name="indoor-positioning-reference" type="indoor-positioning-
reference"/>
<xs:complexType name="indoor-positioning-reference">
   <xs:sequence>
      <xs:element name="resultStatus" type="xs:string" minOccurs="1"
                  maxOccurs="1"/>
      <xs:element name="size" type="xs:integer" minOccurs="0"
                  maxOccurs="1"/>
      <xs:element name="reference" type="xs:string" minOccurs="0"
                  maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```



## 9 Requirements

This document defines use cases and message interfaces between a P/V-ITS-S and a C-ITS-S for supporting indoor navigation functionality. Clause 8 and Annex A define the composition of each message in detail.

In the definitions of messages and data types, there are mandatory, optional or conditional fields. Mandatory fields shall be provided, and conditions for conditional fields shall be satisfied. Such cardinality of fields in message definitions can be considered as kinds of requirements for the interfaces. For example, in “retrieve-indoor-maps” message, identifiers of indoor maps need to be given.

Specific encoding of each message and data types can be adapted for implementation. There may be additional requirements for specific encoding.

# Annex A
(normative)

# Data type

## A.1 Location

| Type | Name | Location | | |
|---|---|---|---|---|
| | Description | Describe a location. | | |
| **Attributes** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| spaceIdentifier | string | O | 1 | Identifier of an indoor space in which this location is located[a] |
| x-coordinate | Real | M | 1 | X coordinate of a location |
| y-coordinate | Real | M | 1 | Y coordinate of a location |
| z-coordinate | Real | O | 1 | Z coordinate of a location if the location to be expressed has 3 dimensions |
| floor | string | O | 1 | Floor number or indicator of a location if the location to be expressed is located in an indoor space[b] |
| alias | string | O | 1 | An alias of a location[c] |
| description | string | O | 1 | Additional description about a location |
| horizontalCRS | string | O | 1 | Identifier of a horizontal coordinate reference system[d,e] |
| verticalCRS | string | O | 1 | Identifier of a vertical coordinate reference system[d,e] |
| **Note** | | | | |

[a] How to construct an identifier of an indoor space is out of the scope of this document.

[b] Floor information of an indoor space can be different case by case. For example, numbers such as 1, 2, … etc., are possible and strings such as “B” “1.5F” are also possible.

[c] This field can be used for a location with an alias that is meaningful in some circumstances. Some mechanisms in ISO 19112 might be used.

[d] It is specified in ISO 19111. It can be EPSG codes in string format.

[e] This field might be useful for description of a location. If several locations are used in a set or list form, use of this field for a location may cause meaningless repetition.

**VIDF Config**

```
dataType {
   { dataTypeId 100, type string: { } },
   { dataTypeId 101, name { textId 20000, longname "coordinate" },
      type lnumeric: { decimalPlaces 5, unitId 68, factor 1, quotient 80000000,
                       addend 0, min -1440000000, max 1440000000 } },
   { dataTypeId 102, name { textId 20001, longname "location" },
      type structure: { 100, 101, 101, 101, 100, 100, 100, 100, 100 } }
}
```

**XML schema example**

```
<xs:element name="Location" type="Location"/>
<xs:complexType name="Location">
   <xs:sequence>
      <xs:element name="spaceIdentifier" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="x" type="xs:double" minOccurs="1" maxOccurs="1"/>
      <xs:element name="y" type="xs:double" minOccurs="1" maxOccurs="1"/>
      <xs:element name="z" type="xs:double" minOccurs="0" maxOccurs="1"/>
      <xs:element name="floor" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="alias" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="description" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="horizontalCRS" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="verticalCRS" type="xs:string" minOccurs="0" maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```

## A.2 IndoorPOI

| **Type** | **Name** | **IndoorPOI** | | |
|---|---|---|---|---|
| | **Description** | Describe an indoor POI | | |
| **Attributes** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| name | string | M | 1 | Name of the POI |
| identifier | string | M | 1 | Identifier of the POI[a] |
| location | location | M | 1 | Location of the POI (see Location data type in Annex A) |
| address | string | O | 1 | Address of the POI |
| description | string | O | 1 | Description about the POI |
| category1 | string | O | 1 | First category of the POI[b] |
| category2 | string | O | 1 | Second category of the POI[b], if available |
| keywords | string | O | N | Descriptive keywords about the POI |
| contact | string | O | 1 | Contact information related to the POI, for example, the phone number. |
| validFrom | date | O | 1 | Date from when the POI is valid |
| validTo | date | O | 1 | Date until when the POI is valid |
| **Note** | | | | |
| [a] How to construct an identifier of an indoor POI is out of the scope of this document. | | | | |
| [b] Specific categories of indoor POIs are on a specific implementation. | | | | |

**VIDF Config**

```
dataType {
   { dataTypeId 100, type string: { } },
   -- refer Annex A.1 for dataTypeId 102 --
   { dataTypeId 103, name { textId 20002, longname "set of strings" },
      type array: 100 },
   { dataTypeId 104, name { textId 20003, longname "an indoor POI" },
      type structure: { 100, 100, 102, 100, 100, 100, 100, 103, 100, 100, 100, 100 } },
    ...
}
```

**XML schema example**

```
<xs:element name="IndoorPOI" type="IndoorPOI"/>
<xs:complexType name="IndoorPOI">
   <xs:sequence>
      <xs:element name="name" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:element name="identifier" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:element name="location" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:element name="address" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="description" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="category1" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="category2" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="keywords" type="xs:string" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="contact" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="validFrom" type="xs:date" minOccurs="0" maxOccurs="1"/>
      <xs:element name="validTo" type="xs:date" minOccurs="0" maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```

## A.3 SearchRegion

| **Type** | **Name** | **SearchRegion** |
|---|---|---|
| | **Description** | Describes a region used for a search |

**Attributes**

| Name | Type | M/O | MO | Description |
|---|---|---|---|---|
| polygonalRegion | PolygonRegion | C[a] | 1 | Polygonal region (see PolygonRegion data type in Annex A) |
| circleRegion | CircleRegion | C[a] | 1 | Circle region (see CircleRegion data type in Annex A) |
| pathRegion | PathRegion | C[a] | 1 | Region in a path form (see PathRegion data type in Annex A) |
| horizontalCRS | string | O | 1 | Identifier of horizontal coordinate reference system[b,c] |
| verticalCRS | string | O | 1 | Identifier of vertical coordinate reference system[b,c] |
| verticalRange | VerticalRange | O | 1 | Vertical range (see VerticalRange data type in Annex A)[c] |

**Note**

[a] Only one of them should be given.

[b] It is specified in ISO 19111. It can be EPSG codes in string forms.

[c] These fields are applied to all types of regions in this type.

**VIDF Config**

```
dataType {
   { dataTypeId 100, type string: { } },
   -- refer Annex A.4 for dataTypeId 108 --
   -- refer Annex A.5 for dataTypeId 109 --
   -- refer Annex A.6 for datatypeId 110 --
   -- refer Annex A.10 for datatypeId 111 --
   { dataTypeId 112, name { textId 20011,
                            longname "a search region" },
      type structure: { 108, 109, 110, 100, 100, 111 }, convention optional },
   ...
}
```

**XML schema example**

```
<xs:element name="SearchRegion" type="SearchRegion"/>
<xs:complexType name="SearchRegion">
   <xs:sequence>
      <xs:element name="polygonalRegion" type="PolygonRegion" minOccurs="0"
                  maxOccurs="1"/>
      <xs:element name="circleRegion" type="CircleRegion" minOccurs="0" maxOccurs="1"/>
      <xs:element name="pathRegion" type="PathRegion" minOccurs="0" maxOccurs="1"/>
      <xs:element name="horizontalCRS" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="verticalCRS" type="xs:string" minOccurs="0" maxOccurs="1"/>
      <xs:element name="verticalRange" type="VerticalRange" minOccurs="0"
                  maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```

## A.4 PolygonRegion

| **Type** | **Name** | **PolygonRegion** | | |
|---|---|---|---|---|
| | **Description** | Describes a polygonal region. | | |
| **Attributes** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| points | Location | M | N | Points defining a polygon (see Location data type in Annex A) |
| **Note** | | | | |
| None. | | | | |

**VIDF Config**

```
dataType {
   -- refer Annex A.1 for dataTypeId 102 --
   { dataTypeId 106, name { textId 20005, longname "a list of locations" },
      type array: 102 },
   { dataTypeId 108, name { textId 20007, longname "a polygonal region" },
      type structure: { 106 } },
   ...
}
```

**XML schema example**

```
<xs:element name="PolygonRegion" type="PolygonRegion"/>
<xs:complexType name="PolygonRegion">
   <xs:sequence>
      <xs:element name="points" type="xs:string" minOccurs="3" maxOccurs="unbounded"/>
   </xs:sequence>
</xs:complexType>
```

## A.5 CircleRegion

| **Type** | **Name** | **CircleRegion** | | |
|---|---|---|---|---|
| | **Description** | Describes a circle region. | | |
| **Attributes** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| center | Location | M | 1 | Center point of the circle region (see Location data type in Annex A) |
| radius | Real | M | 1 | Radius of the circle region[a] |
| uom | String | O | 1 | Unit[b] of measure for radius |
| **Note** | | | | |
| [a] Distance in the unit of measure specified using uom. If uom is not given, meter is used as a default. | | | | |
| [b] Measures related to distance in the International System of Units (SI) is used. | | | | |

**VIDF Config**

```
dataType {
   -- refer Annex A.1 for dataTypeId 102 --
   { dataTypeId 107, name { textId 20006, longname "distance in meters" },
      type numeric: { decimalPlaces 0, unitId 0, factor 1, quotient 1, addend 0 } },
   { dataTypeId 109, name { textId 20008, longname "a circle region" },
      type structure: { 102, 107 } },
   ...
}
```

**XML schema example**

```
<xs:element name="CircleRegion" type="CircleRegion"/>
<xs:complexType name="CircleRegion">
   <xs:sequence>
      <xs:element name="center" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:element name="radius" type="xs:double" minOccurs="1" maxOccurs="1"/>
      <xs:element name="uom" type="xs:string" minOccurs="0" maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```

## A.6 PathRegion

| **Type** | **Name** | **PathRegion** | | |
|---|---|---|---|---|
| | **Description** | Describes a region in path form. | | |
| **Attributes** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| path | Location | M | N | List of locations consisting of a path including the start and destination (see Location data type in Annex A) |
| bufferDistance | Real | M | 1 | Distance from the described path[a] |
| uom | String | O | 1 | Unit [b] of measure for bufferDistance |
| **Note** | | | | |
| [a] Distance in the unit of measure specified using uom. If uom is not given, meter is used as a default. | | | | |
| [b] Measures related to distance in International System of Units (SI) is used. | | | | |

**VIDF Config**

```
dataType {
   -- refer Annex A.1 for dataTypeId 102 --
   { dataTypeId 106, name { textId 20005, longname "a list of locations" },
      type array: 102 },
   { dataTypeId 107, name { textId 20006, longname "distance in meters" },
      type numeric: { decimalPlaces 0, unitId 0, factor 1, quotient 1, addend 0 } },
   { dataTypeId 110, name { textId 20009, longname "a path region" },
      type structure: { 106, 107 } },
   ...
}
```

**XML schema example**

```
<xs:element name="PathRegion" type="PathRegion"/>
<xs:complexType name="PathRegion">
   <xs:sequence>
      <xs:element name="path" type="xs:string" minOccurs="1" maxOccurs="1"/>
      <xs:element name="bufferDistance" type="xs:double" minOccurs="1" maxOccurs="1"/>
      <xs:element name="uom" type="xs:string" minOccurs="0" maxOccurs="1"/>
   </xs:sequence>
</xs:complexType>
```

## A.7 IndoorSpace

| Type | Name | IndoorSpace | | |
|---|---|---|---|---|
| | Description | Describes an indoor space in a building or artificial structure. | | |
| **Attributes** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| identifier | string | M | 1 | Identifier of an indoor space[a] |
| version | string | O | 1 | Version of an indoor space |
| name | string | O | 1 | Name of an indoor space |
| alternativeName | string | O | 1 | Alternative name of an indoor space |
| address | string | O | 1 | Address of an indoor space |
| boundary | Location | M | N | Polygonal boundary of an indoor space |
| horizontalCRS | string | O | 1 | Identifier of horizontal coordinate reference system[b] |
| verticalCRS | string | O | 1 | Identifier of vertical coordinate reference system[b] |
| description | string | O | 1 | Description of an indoor space |
| contact | string | O | 1 | Contact information about an indoor space |
| category1 | string | O | 1 | First category of an indoor space[c] |
| category2 | string | O | 1 | Second category of an indoor space[c], if available |
| descriptiveKeywords | string | O | N | Descriptive keywords about an indoor space |
| validFrom | date | O | 1 | Date when an indoor space was valid from |
| validTo | date | O | 1 | Date when an indoor space is valid to |
| availableIndoorMapTypes | IndoorMapType | C[d] | N | Types of indoor maps available in an indoor space (see IndoorMapType code list in Annex B) |
| availableIndoorMapIdentifiers | string | C[d] | N | Identifiers of indoor maps available in this indoor space[e] |
| availableIndoor PositioningTypes | Indoor PositioningType | C[d] | N | Types of indoor positioning reference data in an indoor space (see IndoorPositioningType code list in Annex B) |
| availableIndoorPositioning ReferenceTypes | IndoorPositioning ReferenceType | C[d] | N | Types of indoor positioning references available in an indoor space (see IndoorPositioningReferenceType code list in Annex B) |
| availableIndoorPositioning References | string | C[d] | N | Identifiers of indoor positioning references available in this indoor space[e] |
| **Note** | | | | |
| [a] How to construct an identifier of an indoor space, i.e. the composition of an indoor space identifier is out of the scope of this document. | | | | |
| [b] It is specified in ISO 19111. It can be EPSG codes in string forms. This coordinate reference system is applied to the boundary field. | | | | |
| [c] Specific categories of indoor spaces depend on a specific implementation. | | | | |
| [d] If there are any indoor maps or indoor positioning references inside this space, these fields should be given. | | | | |
| [e] How to construct an identifier of an indoor map or indoor positioning reference, that is, the composition of an identifier is out of the scope of this document. | | | | |

| Type | Name | IndoorSpace | | |
|---|---|---|---|---|
| | Description | Describes an indoor space in a building or artificial structure. | | |
| **Attributes** | | | | |
| **Name** | **Type** | **M/O** | **MO** | **Description** |
| **VIDF Config** | | | | |

```
dataType {
   { dataTypeId 100, type string: { } },
   -- refer Annex A.1 for dataTypeId 102 --
   { dataTypeId 103, name { textId 20002, longname "set of strings" },
      type array: 100 },
   { dataTypeId 106, name { textId 20005, longname "a list of locations" },
      type array: 102 },
   -- refer Annex B.3 for dataTypeId 113 --
   { dataTypeId 114, name { textId 20013, longname "a set of types of indoor maps" },
      type array: 113 },
   -- refer Annex B.2 for dataTypeId 115 --
   { dataTypeId 116, name { textId 20015,
                     longname "a set of types of indoor positionings" },
      type array: 115 }
   -- refer Annex B.4 for dataTypeId 117 --
   { dataTypeId 118, name { textId 20017,
                     longname "a set of types of indoor positioning references" },
      type array: 117 },
   { dataTypeId 119, name { textId 20018,
                           longname "information about an indoor space" },
      type structure: { 100, 100, 100, 100, 100, 106, 100, 100, 100, 100, 100, 103,
                        100, 100, 114, 103, 116, 118, 103 } },
   ...
}
```