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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).

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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.

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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

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.

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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.
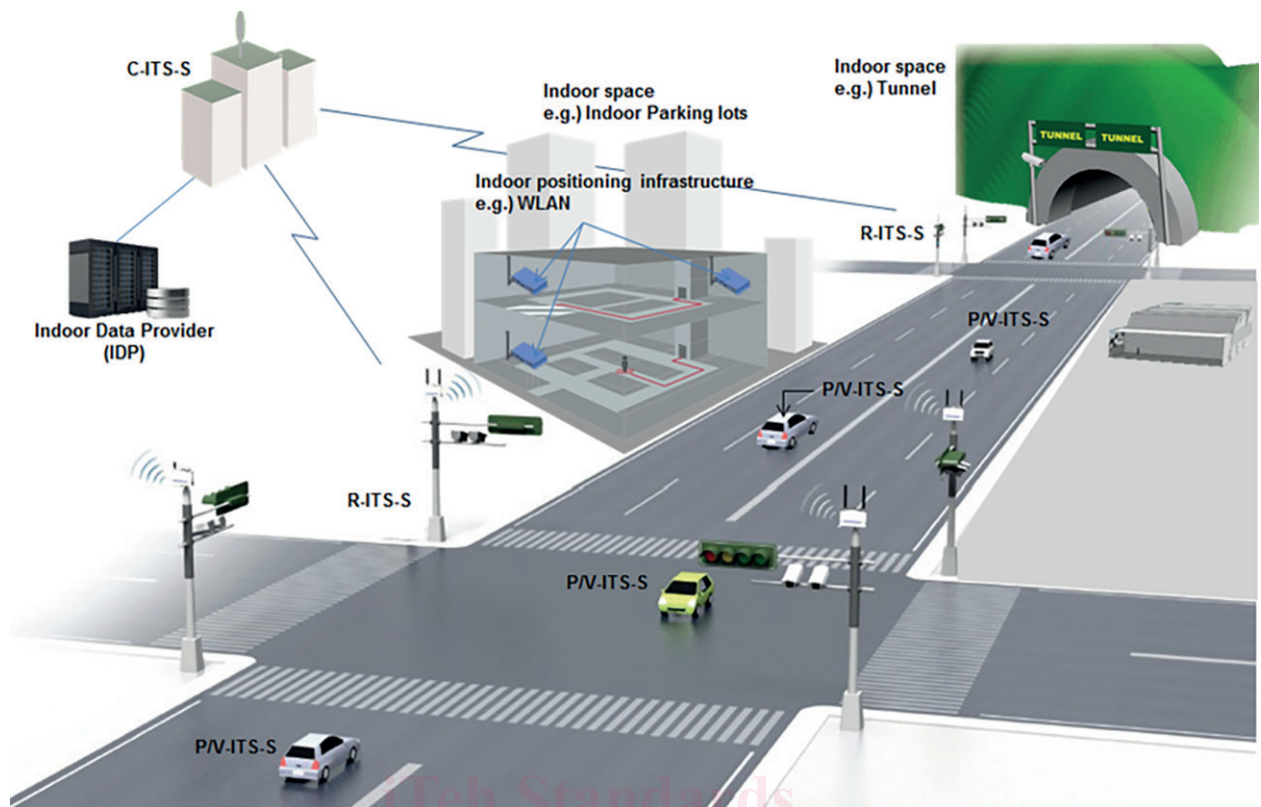
Figure 1 — Concept of indoor navigation

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. UC 1.1 searching for indoor POIs UC 1.1 searching for indoor spaces	1.5 Indoor POI search 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. UC 2.1 searching for indoor maps UC 2.2 retrieving indoor maps UC 2.3 searching for indoor positioning references UC 2.4 retrieving indoor positioning reference	1.10 Indoor map data information request 1.11 Indoor positioning reference data information request 1.12 Indoor map data download 1.13 Indoor positioning reference data download 2.4 Indoor map data provision 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. UC 3.1 setting waypoints at P/V-ITS-S UC 3.2 route planning at P/V-ITS-S UC 3.3 route guidance by P/V-ITS-S	1.1 Indoor map display 1.3 Indoor route planning 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. UC 4.1 setting waypoints at the C-ITS-S UC 4.2 route planning at the C-ITS-S UC 4.3 route guidance by the C-ITS-S	1.1 Indoor map display 1.7 Server-based indoor route planning 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. 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. 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. c) The C-ITS-S searches for candidates of indoor POIs that satisfy the given search conditions. 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. 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. 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. b) The P/V-ITS-S should have appropriate permission to access the C-ITS-S.