BS ISO 17438-1:2016

BSI Standards Publication

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

Part 1: General information and use case definition

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National foreword

This British Standard is the UK implementation of ISO 17438-1:2016.

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

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

Part 1: General information and use case definition

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

Partie 1: Informations générales et définition des cas d'utilisation

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

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

ISO 17438 consists of the following parts, under the general title *Intelligent transport systems — Indoor navigation for personal and vehicle ITS station*:

— *Part 1: General information and use case definition*

The following parts are planned:

— *Part 2: Requirements and specifications for indoor map data format*

— *Part 3: Requirements and specifications for indoor positioning reference data format*

— *Part 4: P/V and central ITS stations interface requirements and specifications for indoor positioning and map data*

Introduction

This part of ISO 17438 defines requirements and specifications for the indoor map data format, positioning reference data, and interface between the P/V ITS station and central ITS station to support indoor navigation.

Applications supporting indoor navigation for personal and vehicle ITS stations need to obtain indoor map data and positioning reference data through the existing ITS station components.

The following standards are subject to analysis regarding their applicability in supporting indoor navigation service provision.

— ISO/TR 10992, *Intelligent transport systems — Use of nomadic and portable devices to support ITS service and multimedia provision in vehicles*

— ISO 14825, *Intelligent transport systems — Geographic Data Files (GDF) — GDF5.0*

— OGC 10-191r1, *Requirements and Space-Event Modelling for Indoor Navigation*

— OGC 12-019, *OGC City Geography Markup Language (CityGML) Encoding Standard*

— CEN/TS 00278207, *Identification of Fixed Objects in Public Transport*

— ISO 24099, *Navigation data delivery structures and protocols*

INTERNATIONAL STANDARD ISO 17438-1:2016(E)

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

Part 1: General information and use case definition

1 Scope

This part of ISO 17438 specifies the indoor navigation system architecture including additional components that are added to the existing ITS system and use cases in providing indoor navigation to various types of users including drivers, passengers, and pedestrians using personal and vehicle ITS stations.

— The personal and vehicle ITS station in the role of end user terminal running indoor navigation functionality.

— Indoor map containing indoor geometry, network topology, and POI data reflecting characteristics of indoor space.

— Indoor positioning reference data containing information of positioning infrastructure: WiFi AP, RFID Reader, Bluetooth AP, etc.

— Data providers to provision the indoor map or indoor positioning reference data.

— Indoor data server registry to provision the information of indoor data server.

— Indoor positioning functionality in the personal and vehicle ITS station using indoor positioning reference data.

— Indoor positioning functionality in the central ITS station using indoor positioning reference data.

— Interface between the P/V ITS station and central ITS station to communicate indoor map data and indoor positioning reference data.

This part of ISO 17438 includes “General Information”, which provides a general overview and structure of each part of ISO 17438. It also specifies “Use Cases” related to the indoor navigation for personal and vehicle ITS stations.

2 Normative references

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

ISO/TR 10992, *Intelligent transport systems — Use of nomadic and portable devices to support ITS service and multimedia provision in vehicles*

3 Terms, definitions, symbols, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 10992 and the following apply.

3.1.1
indoor navigation
location-based service to guide user to destination using *indoor map data* (3.1.3) and the current location of the user in *indoor space* (3.1.2)

3.1.2
indoor space
area limited to an artificial structure (building, tunnel, etc.) and not available to conventional satellite-based positioning systems such as GPS

3.1.3
indoor map data
data to present information about *indoor space* (3.1.2)

Note 1 to entry: It includes indoor geometry, network topology, and POI data.

3.1.4
indoor positioning reference data
group of information that can be used to determine a P/V ITS station or user's position

Note 1 to entry: Detailed compositions vary depending on the positioning technologies, such as WiFi, RFID, etc.

3.1.5
indoor positioning
process of deciding location of P/V ITS station in the *indoor space* (3.1.2)

3.1.6
indoor-outdoor seamless navigation
route guidance service between indoor and outdoor environments and/or vice versa

3.2 Abbreviated terms

GPS Global Positioning System

OGC Open Geospatial Consortium

PND Personal Navigation Device

POI Point Of Interest

P/V Personal/Vehicle

RFID Radio Frequency Identification

RG Route Guidance

RP Route Planning

TBT Turn By Turn

XML Extensible Mark-up Language

4 General information

4.1 Document overview and structure

ISO 17438 provides all documents and references required to support the implementation of indoor navigation. ISO 17438 consists of the following documents.

— Part 1: General information and use case definitions

This part provides an overview of the document set and structure along with the use case definitions and a common set of resources (definitions, references) for all subsequent parts.

— Part 2: Requirements and specifications for indoor map data format

This part specifies all technical requirements and provides a materialized specification for map exchange when a P/V ITS station downloads indoor map data from central ITS station.

— Part 3: Requirements and specifications for indoor positioning reference data format

This part specifies all technical requirements in regards to the indoor positioning reference data format; these technical requirements are used to determine the locations of P/V stations with reference to the corresponding indoor map data.

— Part 4: Requirements and specifications for interface between P/V and central ITS stations

This part specifies the interface requirements for map and indoor positioning reference data related to the personal, vehicle, and central ITS stations.

Figure 1 shows the document structure of the "Indoor navigation for P/V ITS stations" document set.

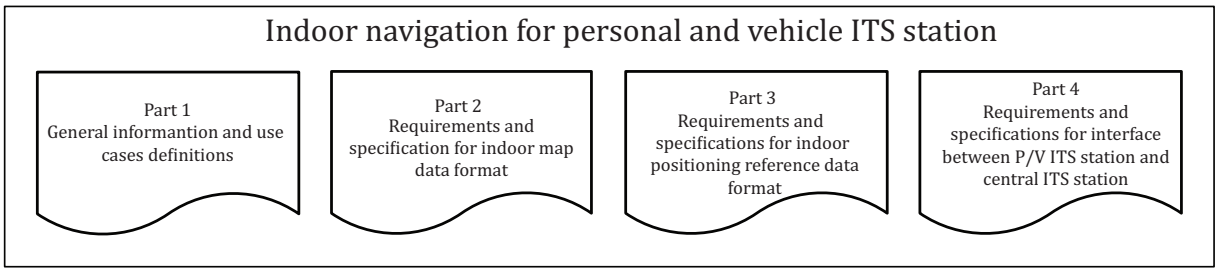


Figure 1 — Document structure

4.2 Purpose of this part of ISO 17438

The main purposes of this part of ISO 17438 are to

a) identify the requirements for indoor navigation,

b) identify the usability of existing International Standards for indoor navigation,

c) identify additional tasks required to develop the specification of indoor map and indoor positioning reference data format, and

d) identify additional tasks required to develop common software interfaces between P/V ITS station and central ITS station.

4.3 Indoor navigation system architecture

By default, indoor navigation system architecture follows the existing ITS communication architecture with additional indoor navigation functionality. Therefore, the following four basic components are also included in the indoor navigation architecture:

— the vehicle subsystem component (Vehicle Station);

— the mobile subsystem component (Personal Station);

— the roadside subsystem component (Roadside Station);

— the central subsystem component (Central Station).

However, in the indoor navigation system architecture, the vehicle station and personal station share the same functionalities and roles from the perspective of a mobile user. Therefore, in this part of ISO 17438, the two components will be referred to as a combined component called “P/V ITS Station”.

To offer indoor navigation functionality, additional necessary elements are defined as follows:

— the indoor map data;

— the indoor positioning reference data;

— the indoor map data provider;

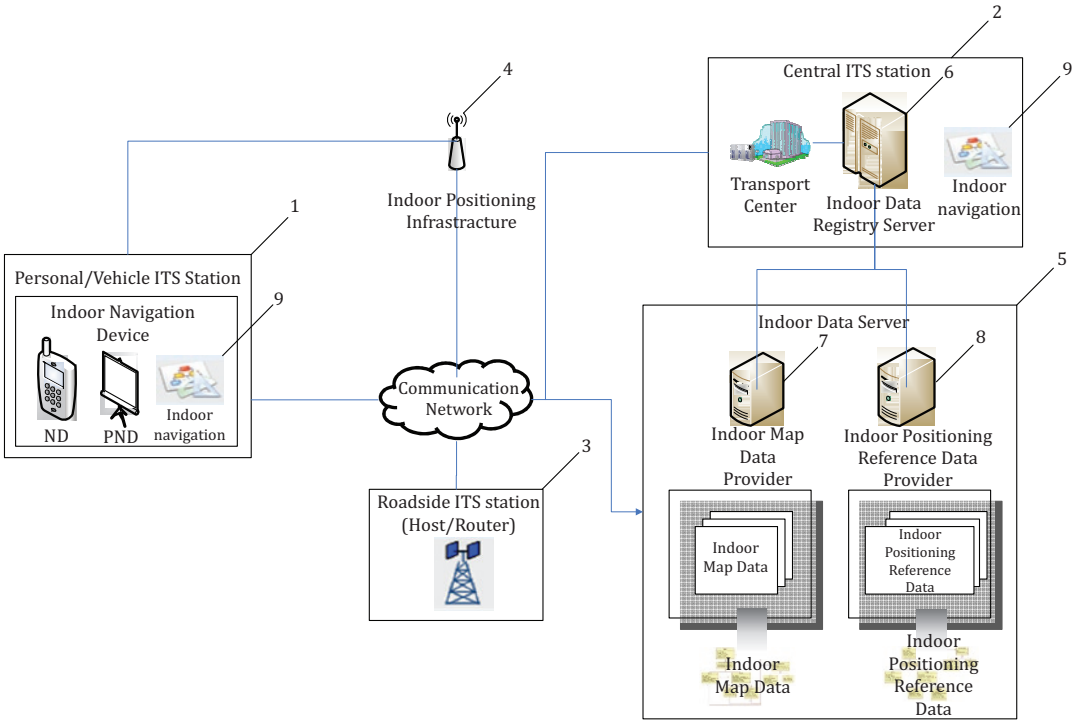
— the indoor positioning reference data provider with indoor positioning engine;

— the indoor data server registry;

— the indoor navigation function modules in the personal, vehicle, and central ITS stations;

— the indoor positioning infrastructure.

Figure 2 shows the indoor navigation system designed for ITS.



Key

1 P/V ITS Station – Mobile subsystem component and Vehicle subsystem component

2 Central ITS Station – Central subsystem component

3 Roadside ITS Station – Roadside subsystem component

4 Indoor Positioning Infrastructure– Indoor positioning subsystem component

5 Indoor Data Server – Local data server component

6 Indoor Data Server Registry – Management subsystem component for indoor map and indoor positioning reference data

7 Indoor Map data Provider – Indoor map gathering subsystem component

8 Indoor Positioning Reference data Provider – Indoor positioning reference data gathering subsystem component

9 Indoor navigation – Function module for indoor navigation

Figure 2 — Indoor navigation architecture

The indoor navigation system consists of four components added to the existing system. The first component is the indoor data server, which generates and provides indoor map data and indoor positioning reference data for indoor navigation applications. Providers of indoor map data and indoor positioning reference data could be different even for the same indoor space, since there are numerous buildings and structures and providers have their own specialities. Hence, indoor map data and indoor positioning reference data shall be separately managed by the data servers.

The second component is the indoor data server registry in the central ITS station, which manages metadata for indoor map data. When indoor map data are requested by a P/V ITS station, the indoor data server registry, whose URL is already known to the P/V ITS station, replies to the P/V ITS station with the URL of an indoor map data provider managing the requested indoor map data. The P/V ITS station then connects to the indoor map data provider to retrieve the necessary data. The indoor positioning reference data can also be provided in the same way.

There are many indoor map data and indoor positioning reference data providers, so a standard format for indoor map data and indoor positioning reference data are required to increase the interoperability of the constructed indoor map data and indoor positioning reference data.

The third component is the indoor positioning infrastructure. There are many indoor positioning methods depending on the indoor positioning infrastructure. These infrastructures often play the same roles as do roadside ITS stations, while indoor positioning reference data should have information about the infrastructure, position, ID, etc.

The last component is the indoor navigation function module in the P/V ITS station. After downloading indoor map data and indoor positioning reference data, indoor navigation applications display the indoor map data and inform the user of his or her current location in the indoor space. Users may search for POIs and plan indoor routes with the given destination information. In the case of server based navigation, an indoor navigation function module is also available from the Central ITS station.

4.4 Relevant standards

ISO 14825 specifies the conceptual and logical data model and physical encoding formats for geographic databases for Intelligent Transport System (ITS) applications and services. The indoor map data format of this part of ISO 17438 will refer to ISO 14825, especially for seamless indoor and outdoor navigation.

OGC IndoorGML is a candidate OGC standard based on prior discussion of OGC 10-191r1. IndoorGML is an open data model and XML schema for indoor spatial information. Especially, this model focuses on topological relationships between divided spaces depending on semantic usage. For the end user, these relationships are represented in the network data for indoor navigation. The indoor map data of this part of ISO 17438 will refer to the concept and contents of IndoorGML.

OGC 12-019 is a common information model and XML-based encoding for the representation, storage, and exchange of virtual 3D city and landscape models. Level of Detail 4 (LOD4) of this model handles indoor space. The indoor map data format of this part of ISO 17438 will refer to CityGML.

CEN/TS 00278207 is a reference data model describing access to public transportation. Indoor navigation could be related to public transportation hubs and facilities (such as doorways, platforms, and bus stops). This part of ISO 17438 refers to the IFOPT model for public transport features.

ISO 24099 defines the data structures and protocol(s) used in intelligent transport system (ITS) applications for the delivery and updating of map-related data from the Service Centre (SC) to users [In-vehicle Systems (IVS)]. This part of ISO 17438 refers to ISO 24099 for interfaces between P/V and central ITS stations.

5 Use case overview and principles

5.1 Overview

5.1.1 Basic principles for use case definition

Basic principles have been established as guidelines to define use cases.

a) Use cases are categorized by functions of indoor navigation service and indoor data operation.

b) Indoor navigation use cases include existing navigation functions. Additionally, special cases of indoor space are defined: seamlessness between indoor and outdoor transitions, indoor positioning, and so on.

c) The use cases in this part of ISO 17438 define end users' requests of indoor data from the central ITS station for indoor navigation service.

d) Central ITS station collects indoor data server information and provisions the information to P/V ITS stations.

e) End users are drivers and pedestrians who want to use indoor navigation services via nomadic devices (e.g. Smart Phones, Personal Navigation Devices) in order to obtain indoor information, which includes routing information and general/detailed information of specific places.

End users are drivers and pedestrians

5.1.2 Use case clusters

Use cases are grouped into categories referred to as “use case clusters”. Table 1 contains a list of the different use case clusters

Table 1 — Use case clusters

No.	Title of use case cluster	Brief description
1	Indoor navigation service	The use cases belonging to this cluster describe six main functions of the indoor navigation service and special cases for indoor space.
2	Indoor navigation data	The use cases belonging to this cluster describe the format of essential data for indoor navigation; these are indoor map data including emergency situation information and indoor positioning reference data.
3	Indoor navigation data registry	The use cases belonging to this cluster describe how indoor data provider provides indoor navigation data to P/V ITS stations.

Detailed definitions of each use case are provided in Clause 6.

Figure 3 shows all use case clusters and associated use cases. The arrows and circles indicate the dependencies and workflow between the use cases.

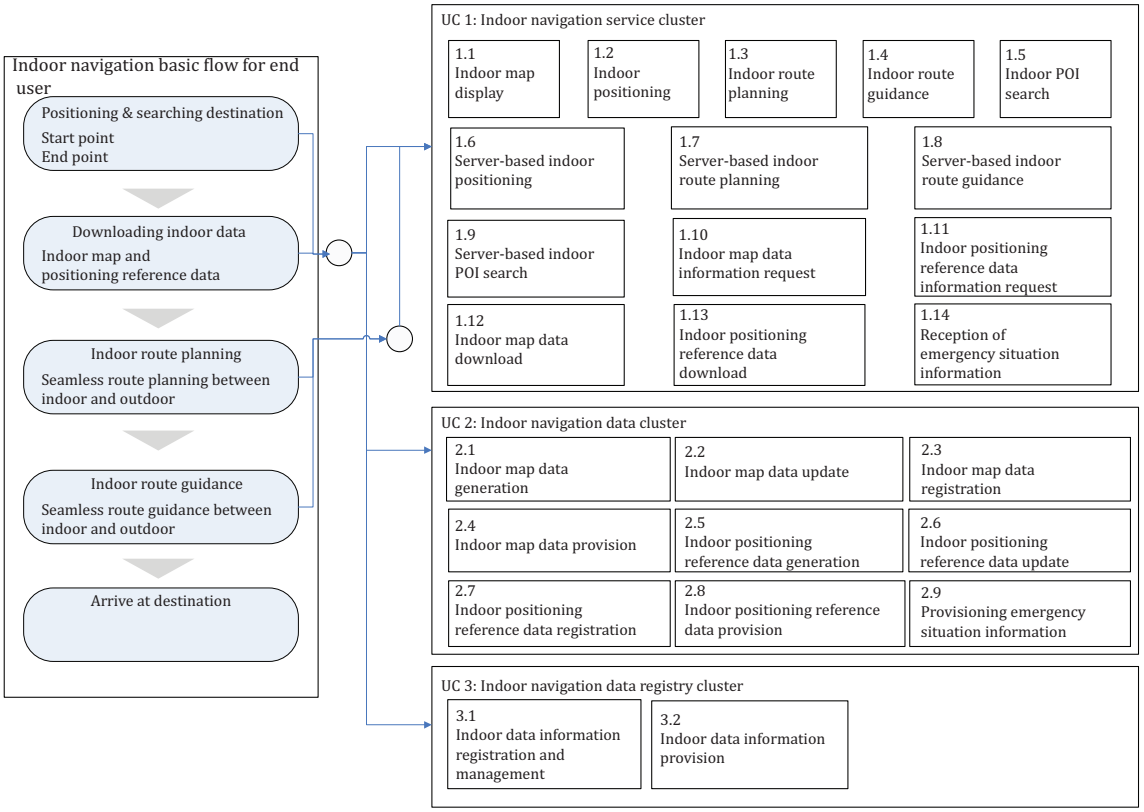


Figure 3 — Use case workflow and dependencies

6 Use case definition

6.1 UC 1 Indoor navigation service cluster

6.1.1 UC 1.1 Indoor map display

Table 2 specifies the use case in which P/V ITS station displays indoor map data given binary or XML form of indoor map data.

Table 2 — Indoor map display

Use case name	Indoor map display
Actor	P/V ITS station (initiated by user interaction or automatically)
Goal	Display indoor map data
Use case input	Indoor map data (binary or XML)
Use case output	Display the indoor map data on the screen of a P/V ITS Station
Brief description	Indoor map data consist of geometry data for indoor space, network topology, and POI. Map display module shows these indoor map data, which can be displayed in 2D or 3D forms.

6.1.2 UC 1.2 Indoor positioning

Table 3 specifies the use case in which P/V ITS station determines the user's location with indoor positioning reference data and measured value from indoor positioning infrastructure.

Table 3 — Indoor positioning

Use case name	Indoor positioning
Actor	P/V ITS station (initiated by user interaction or automatically)
Goal	Determines the P/V ITS station location
Use case input	Indoor positioning reference data and measured value from indoor positioning infrastructure
Use case output	Location of the P/V ITS station
Brief description	Given indoor positioning reference data and some additionally measured values of the P/V ITS station, the P/V station determines the location of the station. The input and output of this use case is dependent on the positioning technology.

6.1.3 UC 1.3 Indoor route planning

Table 4 specifies the procedure to obtain a list of searched links in network data to find an indoor route to destination with start point, end point, way points, and route plan options.

Table 4 — Indoor route planning

Use case name	Indoor route planning
Actor	P/V ITS station (initiated by user interaction or automatically)
Goal	Find route from start point to end point
Use case input	Start point, end point, way points, and route plan options
Use case output	List of searched links in network data

Table 4 *(continued)*

Brief description	Indoor route planning is a path finding function to a destination. Start point, way points, and end point are set by user. Route plan options depend on the type of pedestrian and can be categorized by certain criteria such as disabled/non-disabled person, use of wheelchair, use of stairs or elevator, and time constraint.

6.1.4 UC 1.4 Indoor route guidance

Table 5 defines the use case in which P/V station provides guidance information to destination with route planning result and the current location of the user.

Table 5 — Indoor route guidance

Use case name	Indoor route guidance
Actor	P/V ITS station (initiated by user interaction or automatically)
Goal	Guide the user along route
Use case input	Route planning result, current location of user
Use case output	Guidance information along the route planning result
Brief description	Indoor route guidance function provides guidance information in addition to the route planning result. It provides user with directions from the current location to the destination by giving instructions such as left-turn, right-turn, and go-straight. Guidance information can be provided as a type of TBT. Guidance information can be displayed on an indoor map or output via different media.

6.1.5 UC 1.5 Indoor POI search

Table 6 defines the use case in which P/V ITS station searches for indoor POI that corresponds to the search word and returns detailed information of indoor POI.

Table 6 — Indoor POI search

Use case name	Indoor POI search
Actor	P/V ITS station (initiated by user interaction)
Goal	Provide POI information to user
Use case input	Search keyword
Use case output	List of search results and details
Brief description	Indoor POI information is used to find start point and end point, and to show POI details. POI information can consist of name, address, phone number, business hours, etc. User can search for specific POI by providing specific POI information.

6.1.6 UC 1.6 Server based indoor positioning

Table 7 defines the use case in which Central ITS station determines the user's location with positioning system; this function is included among Central ITS station's functionalities.

Table 7 — Server based indoor positioning

Use case name	Server based indoor positioning
Actor	Central ITS station (Indoor positioning reference data provider) (initiated by P/V ITS Station)
Goal	Determine the P/V ITS station location
Use case input	Indoor positioning reference data and measured value from P/V ITS station

Table 7 *(continued)*

Use case output	Location of the P/V ITS station
Brief description	Indoor positioning can be done on central ITS station. Using the given indoor positioning reference data and some additionally measured values from P/V ITS station, the location of P/V ITS station can be determined. The input and output of this use case are dependent on the positioning technology. After determining the position of P/V ITS station, location information of requested station is transmitted to P/V ITS station from central ITS station.

6.1.7 UC 1.7 Server based indoor route planning

Table 8 specifies the procedure of indoor route planning by Central ITS station.

Table 8 — Server based indoor route planning

Use case name	Server based indoor route planning
Actor	Central ITS station (initiated by P/V ITS Station)
Goal	Find route from start point to end point
Use case input	Start point, end point, way points, and route plan options from P/V ITS station
Use case output	List of searched links in network data
Brief description	Indoor route planning, a path finding function from start to end point indoors, can be done by Central ITS station. Start point, way points, and end point are given by P/V ITS station. Route plan options depend on the type of pedestrian, which can be categorized according to certain criteria such as disabled/non-disabled person, use of wheelchair, use of stairs or elevator, and time constraint. After finding route according to request from P/V ITS station, the result of route planning is transmitted to P/V ITS station. Server based route planning may use dynamic information such as flow of passengers by hour, etc.

6.1.8 UC 1.8 Server based indoor route guidance

Table 9 defines the procedure of combining the guidance information and route planning result from Central ITS station and displaying the combined information on P/V ITS station.

Table 9 — Server based indoor route guidance

Use case name	Server based indoor route guidance
Actor	Central ITS station (initiated by P/V ITS Station)
Goal	Guide the user along route
Use case input	Route planning result
Use case output	Guidance information along with the route planning result
Brief description	Indoor route guidance information can be generated by Central ITS station. Central ITS station combines the guidance information and route planning result and transmits the combined information to P/V ITS station. P/V ITS station then guides user along route with this guidance information.

6.1.9 UC 1.9 Server based indoor POI search

Table 10 defines the use case in which indoor data server in Central ITS station searches for POI information.

Table 10 — Server based indoor POI search

Use case name	Server based indoor POI search
Actor	Indoor data server (initiated by P/V ITS Station)
Goal	Provide POI information to user
Use case input	Search keyword
Use case output	List of search results and details
Brief description	Indoor map data and POI data can be managed separately by indoor data server. In this case, indoor POI search can be done by the indoor data server. When P/V ITS station requests POI information with search keyword, indoor data server searches for the POI information that corresponds to the search keyword and then transmits a list of searched results to P/V ITS station.

6.1.10 UC 1.10 Indoor map data information request

Table 11 defines the use case in which P/V ITS station requests metadata information of indoor map data from indoor data registry sever.

Table 11 — Indoor map data information request

Use case name	Indoor map data information request
Actor	P/V ITS station (initiated by user interaction or automatically)
Goal	Obtain metadata information of the indoor map data
Use case input	Current location of user or search keyword
Use case output	Metadata information of indoor map data such as identifier, creation date, data provider, and download address, etc.
Brief description	P/V ITS station sends request to indoor data server registry along with current location or search keyword as input. Indoor data server registry then responds with corresponding metadata information of indoor map data based on location or keyword.

6.1.11 UC 1.11 Indoor positioning reference data information request

Table 12 defines the use case in which P/V ITS station requests metadata information of indoor positioning reference data from indoor data registry sever.

Table 12 — Indoor positioning reference data information request

Use case name	Indoor positioning reference data information request
Actor	P/V ITS station (initiated by user interaction or automatically)
Goal	Obtain metadata information of the indoor positioning reference data
Use case input	Current location of user or search keyword
Use case output	Metadata information of indoor positioning reference data such as identifier, creation date, data provider, compatible indoor map data, etc.
Brief description	P/V ITS station sends request to indoor data server registry along with current location or search keyword as input. Indoor data server registry then responds with corresponding metadata information of indoor positioning reference data based on location or keyword.

6.1.12 UC 1.12 Indoor map data download

Table 13 defines the use case in which P/V ITS station downloads the indoor map data from indoor map data provider.

Table 13 — Indoor map data download

Use case name	Indoor map data download
Actor	P/V ITS station
Goal	Download the indoor map data
Use case input	Indoor map data download address
Use case output	Indoor map data
Brief description	P/V ITS station downloads indoor map data with download address, which is acquired by Indoor map data information request.

6.1.13 UC 1.13 Indoor positioning reference data download

Table 14 defines the use case in which P/V ITS station downloads the indoor positioning reference data from indoor positioning reference data provider.

Table 14 — Indoor positioning reference data download

Use case name	Indoor positioning reference data download
Actor	P/V ITS station
Goal	Download the indoor positioning reference data
Use case input	Indoor positioning reference data download address
Use case output	Indoor positioning reference data
Brief description	P/V ITS station downloads indoor map data with download address, which is acquired by Indoor positioning reference data information request.

6.1.14 UC 1.14 Reception of emergency situation information

Table 15 defines the use case in which P/V ITS station receives emergency situation information from the central ITS station.

Table 15 — Reception of emergency situation information

Use case name	Reception of emergency situation information
Actor	P/V ITS station
Goal	Alert user or re-route current paths
Use case input	
Use case output	Reception of emergency situation information
Brief description	When receiving emergency situation information, the P/V ITS station warns users about emergency situations. The emergency information may include firewalls blocking escape paths or dangerous spaces. In such cases, safe evacuation routes can be provided automatically.

6.2 UC 2 Indoor navigation data cluster

6.2.1 UC 2.1 Indoor map data generation

Table 16 defines the use case in which indoor map data provider generates indoor map data based on given reference data such as CAD, BIM, image, etc.

Table 16 — Indoor map data generation

Use case name	Indoor map data generation
Actor	Indoor map data provider
Goal	Generate indoor map data consisting of background/space/network/POI data
Use case input	Reference data (CAD, BIM, image, etc.).
Use case output	Indoor map data
Brief description	Indoor map provider generates indoor map data, which consist of background data, space data, network data, and POI data based on provided reference data such as floor plan. Background data are geometry data used to express shape of indoor space configuration. This data could be based on floor plan or image that includes architectural design of indoor space. Space data are a set of spatial extents that are divided by semantic usage in indoor space. For example, rooms, hallways, and sensor coverage would be represented as space data. Network data consist of node and link data for navigation. Network data are generated based on space data. POI data are the details of specific space or spot. This type of data contains name, address, phone number, images, and so on. Although mapping, acquisition, and data processing techniques of indoor map data are not within the scope of this part of ISO 17438, it is essential to explain here what kinds of information are needed for indoor navigation.

6.2.2 UC 2.2 Indoor map data update

Table 17 defines the use case in which indoor map data provider updates indoor map data when interior or POI information has been changed.

Table 17 — Indoor map data update

Use case name	Indoor map data update
Actor	Indoor map data provider
Goal	Update indoor map data to reflect latest situation
Use case input	Reference data (CAD, BIM, image, etc.)
Use case output	Updated indoor map data
Brief description	When the structure of the interior space or POI information has been changed, existing indoor map data have to be updated. The same method is applied as in indoor map data generation.

6.2.3 UC 2.3 Indoor map data registration

Table 18 defines the use case in which indoor map data provider submits the indoor map data information to indoor data server registry after generating or updating indoor map data.

Table 18 — Indoor map data registration

Use case name	Indoor map data registration
Actor	Indoor map data provider
Goal	Register indoor map data to indoor data server registry
Use case input	Metadata information of indoor map data
Use case output	Registration of indoor map data
Brief description	Indoor map data registration is the submission process of metadata information of indoor map data. Indoor data server registry manages the registry of indoor map data and positioning reference data. Indoor data server should perform the registration by sending metadata information of indoor map data (such as identifier, creation date, data provider, and download address, etc.) to indoor data server registry.

6.2.4 UC 2.4 Indoor map data provision

Table 19 defines the use case in which indoor map data provider sends indoor map data to P/V ITS station.

Table 19 — Indoor map data provision

Use case name	Indoor map data provision
Actor	Indoor map data provider
Goal	Transfer indoor map data to P/V ITS station
Use case input	Request for indoor map data download
Use case output	Indoor map data
Brief description	When P/V ITS station searches for certain POIs or route plans based on location (not server based) to a destination in an indoor space, indoor map data have to be stored in the P/V ITS station. If the map data are not stored, P/V ITS station sends a request message to indoor data server in order to download the corresponding map data. After receiving the request from the P/V ITS station, indoor map data provider provisions the indoor map data.

6.2.5 UC 2.5 Indoor positioning reference data generation

Table 20 defines the use case in which indoor positioning reference data provider generates indoor positioning reference data by scanning indoor positioning infrastructure.

Table 20 — Indoor positioning reference data generation

Use case name	Indoor positioning reference data generation
Actor	Indoor positioning reference data provider
Goal	Generate indoor positioning reference data about indoor positioning infrastructure information
Use case input	Scanned measurement values from positioning infrastructure and geometry of indoor map
Use case output	Indoor positioning reference data of infrastructure (ID, type, position, etc.)
Brief description	Indoor positioning reference data provider generates indoor positioning reference data by scanning measurement values from positioning infrastructure and geometry of indoor map at each coordinate of the indoor map; these data are matched with the ID of the infrastructure, type of positioning resource, location of infrastructure, and so on. Although collection and data processing techniques of positioning reference data are not within the scope of this part of ISO 17438, it is essential to explain here what kinds of information are needed for indoor navigation.

6.2.6 UC 2.6 Indoor positioning reference data update

Table 21 defines the use case in which indoor positioning reference data provider updates indoor positioning reference data periodically. The provider also has to perform update processes when location of indoor positioning infrastructure changes.

Table 21 — Indoor positioning reference data update

Use case name	Indoor positioning reference data update
Actor	Indoor positioning reference data provider
Goal	Update indoor positioning reference data to reflect latest situation
Use case input	Scanned measurement values from positioning infrastructure and geometry of indoor map

Table 21 *(continued)*

Use case output	Updated indoor positioning reference data of infrastructure (ID, type, position, etc.)
Brief description	If there is a change in structure of interior space or locations of positioning infrastructure, existing indoor positioning reference data have to be updated. Indoor positioning reference data provider updates data by periodically scanning changed information of positioning infrastructure.

6.2.7 UC 2.7 Indoor positioning reference data registration

Table 22 defines the use case in which indoor positioning reference data provider submits information to indoor data server registry after generating or updating indoor positioning reference data.

Table 22 — Indoor positioning reference data registration

Use case name	Indoor positioning reference data registration
Actor	Indoor positioning reference data provider
Goal	Register indoor positioning reference data to indoor data server registry
Use case input	Metadata information of indoor positioning reference data
Use case output	Registration of indoor positioning reference data
Brief description	Indoor positioning reference data registration is the submission process of metadata information of indoor positioning reference data. Indoor data server registry manages the registry of indoor map data and positioning reference data. Indoor data server should perform the registration by sending metadata information of indoor positioning reference data (such as identifier, creation date, data provider, and download address, etc.) to indoor data server registry. Indoor positioning reference data are highly coupled with indoor map data, so indoor positioning reference provider should provide information on which sets of indoor map data can be used together.

6.2.8 UC 2.8 Indoor positioning reference data provision

Table 23 defines the use case in which indoor positioning reference data provider sends indoor positioning reference data to P/V ITS station.

Table 23 — Indoor positioning reference data provision

Use case name	Indoor positioning reference data provision
Actor	Indoor positioning reference data provider
Goal	Transfer indoor positioning reference data to P/V ITS station
Use case input	Request for indoor positioning reference data download
Use case output	Indoor positioning reference data
Brief description	When P/V ITS station determines a location, indoor positioning reference data have to be stored in P/V ITS station. If the data are not stored, P/V ITS station sends the download request to indoor data server. Upon receiving request from P/V ITS station, indoor data server provisions the corresponding indoor positioning reference data.

6.2.9 UC 2.9 Provisioning of emergency situation information

Table 24 defines the use case in which central ITS station sends emergency situation information to P/V ITS station.

Table 24 — Provisioning of emergency situation information

Use case name	Provisioning of emergency situation information
Actor	Central ITS station
Goal	Provisioning emergency situation information to P/V ITS station
Use case input	None (triggered when certain emergency situations occur)
Use case output	Emergency situation information to be transferred
Brief description	When emergency situations occur, central ITS station sends (or broadcasts) the emergency information to P/V ITS stations.

6.3 UC 3 Indoor navigation data registry cluster

6.3.1 UC 3.1 Indoor data information registration and management

Table 25 defines the registration and management procedure for indoor data server registry.

Table 25 — Indoor data server registration and management

Use case name	Indoor data information registration and management
Actor	Central ITS station (Indoor data server registry)
Goal	Registration and management of indoor map and positioning reference data information from multiple providers
Use case input	Information of generated or updated indoor map and indoor positioning reference data
Use case output	Metadata for indoor map and indoor positioning reference data
Brief description	There are many indoor map data and indoor positioning reference data providers. The indoor data server registry of the Central ITS station should manage this indoor data information such as identifier, creation date, data provider, download address, etc., in order to guarantee interoperability.

6.3.2 UC 3.2 Indoor data information provision

Table 26 defines the scenario of providing metadata information of requested indoor data.

Table 26 — Indoor data information provision

Use case name	Indoor data information provision
Actor	Central ITS station (Indoor data server registry)
Goal	Provide indoor data information to P/V ITS station
Use case input	Location or search keyword for indoor space in question
Use case output	Corresponding indoor data information in question
Brief description	End user (P/V ITS station) requests indoor data (indoor map data and indoor positioning reference data) information from central ITS station for use in indoor navigation. Central ITS station provides corresponding indoor data information (metadata and download address of indoor data) based on location or search keyword that was provided by P/V ITS station.

7 Requirements

According to use case definition, the following requirements for indoor navigation have been extracted.

Figure 4 shows the requirements for indoor navigation.

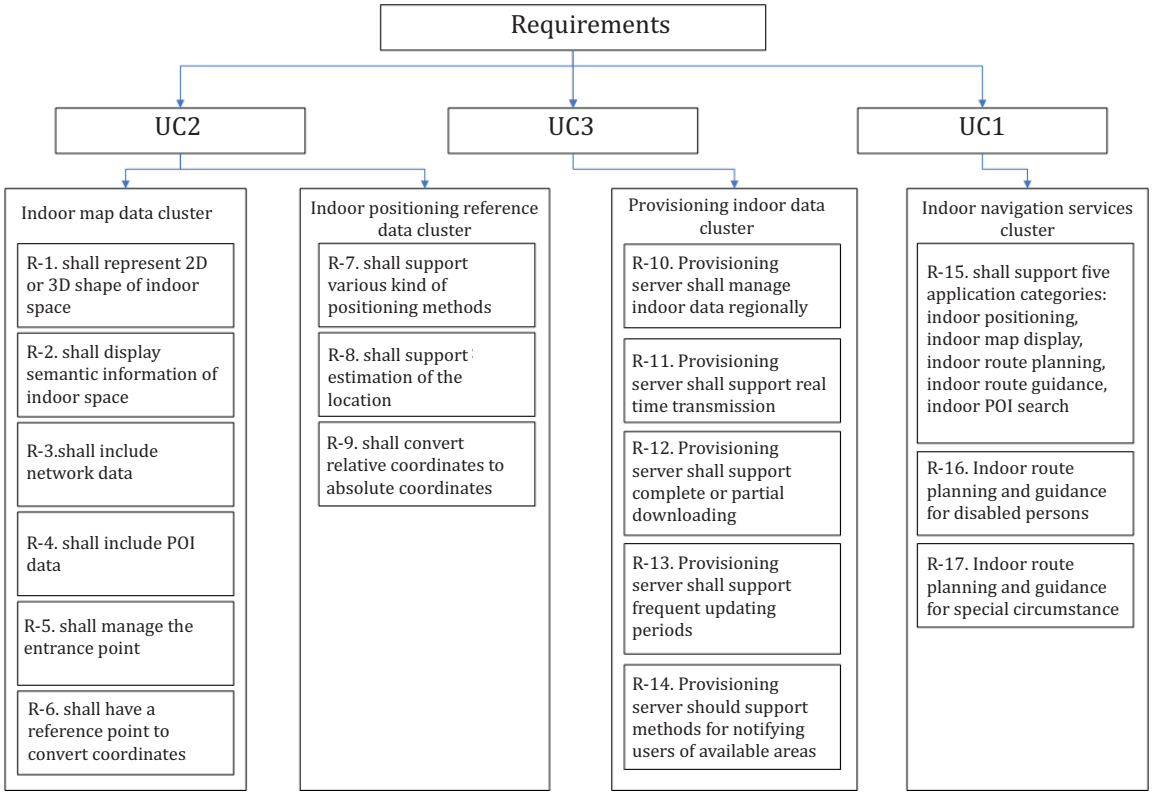


Figure 4 — Requirements for indoor navigation

7.1 Requirements for indoor map data

Indoor map data requirements are defined as follows.

— R-1. Indoor map data can be constructed in 2D or 3D to represent the shape of the indoor space: rooms, corridors, stairs, escalators, elevators, etc.

— R-2. Indoor map data shall support the display of semantic information of the indoor space: conference rooms, classrooms, toilets, stores, etc. The semantic information of the indoor space shall be used to search the POIs and plan indoor routes.

— R-3. Indoor map data shall include network data for route planning and route guidance: nodes, links.

— R-4. Indoor map data shall include POI data for map search: detailed POI information and location.

— R-5. Indoor map data shall support seamless navigation between indoor and outdoor environments by connecting the entrance point to the road/public transport networks or associated by geographical proximity. Also extra links/nodes might be needed in the outdoor map data to make seamless navigation possible.

— R-6. Indoor map data shall have information about coordinate reference system to convert absolute coordinates to relative coordinates.

7.2 Requirements for indoor positioning reference data

Indoor location reference data requirements are defined as follows.

— R-7. Positioning in indoor space shall support various kinds of positioning methods and technologies. Indoor positioning reference data shall include the location of the positioning infrastructure: WiFi AP, NFC, RFID, cell tower, etc.

— R-8. Indoor positioning reference data shall include an estimate of the user's location using measurements made by the indoor positioning infrastructure.

— R-9. Indoor positioning reference data can be constructed using relative coordinates. In order to provide seamless service between indoor and outdoor environments, relative coordinates shall be capable of being converted to absolute coordinates and vice versa.

7.3 Requirements for provisioning of indoor map data and indoor positioning reference data

Requirements for the provisioning of indoor map and location data are defined as follows.

— R-10. Indoor data server registry included in the central ITS server shall manage the indoor map and indoor positioning reference data regionally in terms of similar indoor spaces and support methods for finding indoor map data based on location (geographic areas, coordinates) and the names of POIs. Also, indoor data server registry shall manage emergency situation information, providing it to P/V ITS stations.

— R-11. Depending on the P/V ITS Station's request, indoor data server shall respond to P/V ITS station in real time with indoor map data and indoor positioning reference data.

— R-12. Indoor data server shall support complete or partial downloading of the indoor map data and indoor positioning reference data of the corresponding indoor space.

— R-13. Indoor map and indoor positioning reference data shall be updated when there are changes in indoor spaces or positioning infrastructures.

— R-14. Indoor data server registry shall support method for notifying users when they are in areas in which indoor services are available and support searching of the available indoor space by keyword.

7.4 Requirements for indoor navigation service

Indoor navigation service requirements are defined as follows.

— R-15. Indoor navigation service shall support six application categories: indoor positioning, indoor map display, indoor route planning, indoor route guidance, address location, service, and indoor POI information access.

— R-16. Indoor route planning and guidance shall support disabled persons, allowing them to avoid stairs and escalators, and providing them with information on the widths of corridors.

— R-17. Indoor route planning and guidance shall support special circumstances such as time constraints, restricted areas, and emergency situations.

Annex A
(informative)

Benefit Examples

A.1 Use of indoor navigation for various types of pedestrian

Indoor navigation can be useful for various types of pedestrian. Once users have downloaded indoor map data corresponding to an indoor space and indoor positioning reference data from the indoor data server, non-disabled users can use this information to navigate through complex-structured indoor spaces and reach their final destinations with ease. On the other hand, disabled users can benefit from indoor navigation by planning a route that avoids stairs and escalators and instead provides guidance to facilities such as elevators. Hence, network data within indoor maps will be designed to maximize these benefits.

A.2 Use of seamless indoor and outdoor navigation for drivers

Seamless navigation between indoor and outdoor environments can also benefit drivers in various ways. First, drivers can locate parking spaces near to their destinations using seamless navigation. Not only can drivers locate parking lots, but they can also find their way back from the destination to their cars easily with the help of seamless navigation. The indoor navigation system in the vehicle ITS station can transfer its location and routing information to the driver's personal ITS station, through which the driver can backtrack to his or her car.

A.3 Use of indoor navigation for emergency situations

Indoor navigation can also come in handy during emergency situations such as fires. In such cases, firewalls will block certain passages, which can hinder evacuation. Yet, indoor navigation can compute the shortest path to the nearest fire escape; this path will avoid firewalls because indoor map data can be generated with information on firewall locations. Fire-fighters can also conduct their operations more easily with the help of indoor navigation.

A.4 Use of indoor navigation for public transport transfers

Users can also benefit from indoor navigation when transferring between methods of public transport by using indoor navigation to locate the closest gate for transit. When transferring from train (or airplane) to vehicle, users might be able to find the entrance nearest to the station (airport).

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