

IPIN/ISC – Map Subcommittee

Introduction to standardization activities for indoor navigation

- IEEE MDR, ISO TC204, and ISO TC211-

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Ryan,

ETRI (Electronics and Telecommunications Research Institute),
South Korea

jjryu@etri.re.kr

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- IEEE RAS (Robot & Automation Society)
& MDR (Map Data Representation)
- ISO TC204 Intelligent Transportation System
- ISO TC211 Geographic Information
- Summary and Implications



IEEE RAS (Robot & Automation Society) & MDR (Map Data Representation)

Intro to IEEE RAS and MDR (1/2)

- IEEE RAS (Robotics & Automation Society)
 - Mission
 - To foster the development and facilitate the exchange of scientific and technological knowledge in Robotics and Automation
 - Homepage
 - <http://www.ieee-ras.org/>
 - SCSA (Standing Committee for Standard Activities)
- Working Groups for Standards on IEEE RAS SCSA
 - Ontologies for Robotics and Automation (ORA-P1872)
 - **Map Data Representation (MDR-P1873)**
 - Autonomous Robotics
 - Wearable Robotics

Intro to IEEE RAS and MDR (2/2)

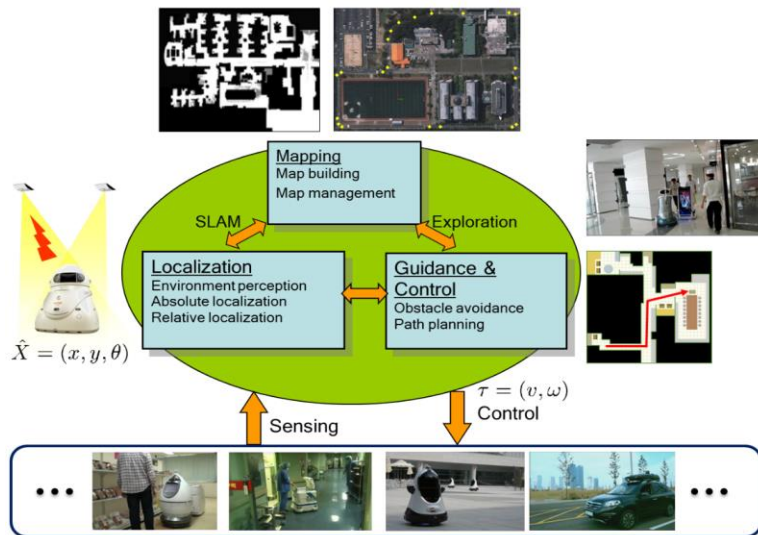
- IEEE MDR (Map Data Representation) WG (P1873)
 - Chairs
 - Francesco Amigoni (francesco.amigoni@polimi.it)
 - ※ Previous chair: Wonpil Yu, ETRI, South Korea (wonpil@etri.re.kr)
 - Scope
 - To standardize a common representation and encoding for map used for navigation by mobile robots.
- Activities for standards
 - 1873-2015 IEEE Standard for Robot Map Data Representation for Navigation
 - approved, 3 sept. 2015.
 - Discussion for 3D map is currently on the table.
 - officially started at Nov. 2016.

1873-2015 Robot Map Representation for Navigation (1/3)




- Scope

- defines a hierarchy of terminologies related to 2D maps for navigation
- specifies a data model for each element of the hierarchy,
- specifies an XML schema for 2D map data exchange between different robots

- Background



<Structure of robot navigation technology>

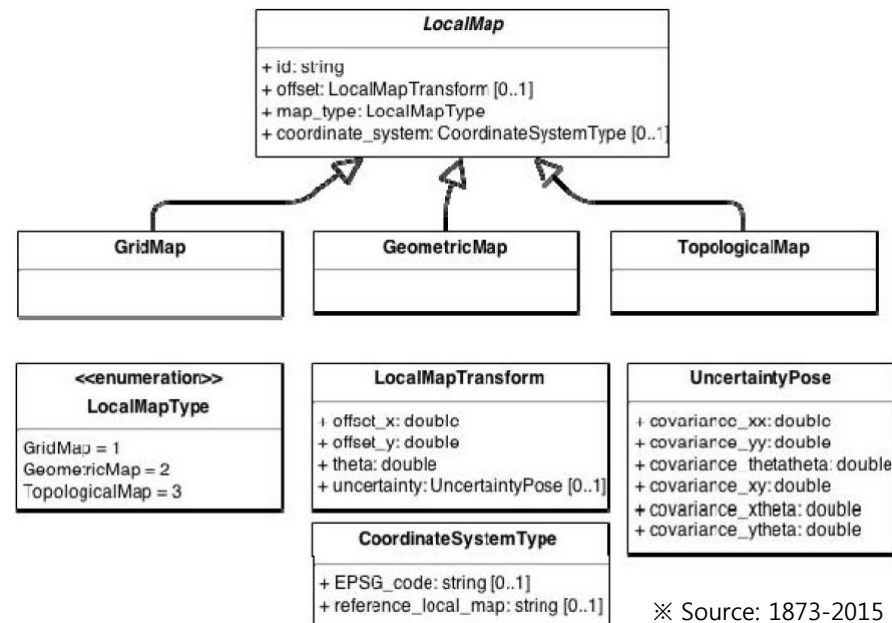
Types	Room scale	Vista scale	Environment scale
Examples	Home, office, shop	Factory, terminal, farm, campus	Town, district, city
Applications	Robot vacuum cleaner, robot companion, entertainment robot	Agricultural robot, logistics robot, surveillance /security robot	Autonomous car, unmanned aerial vehicle, military robot
Typical scenario			
Target standard		ISO map service	ISO GML OGC CityGML
	OGC IndoorGML		
	IEEE Map Data Representation (MDR)		

<Application scope of IEEE 1873 MDR>

※ Source: 1873-2015 Robot Map Representation for Navigation

1873-2015 Robot Map Representation for Navigation (2/3)

- Map data representation for robot navigation
 - Global map
 - set of 2D local maps
 - is a tree consisting of several nodes which represents a local map
 - an edge of nodes in the tree means roto-translations and overlay of maps
 - Local map
 - can be a form of grid, geometric or topological map

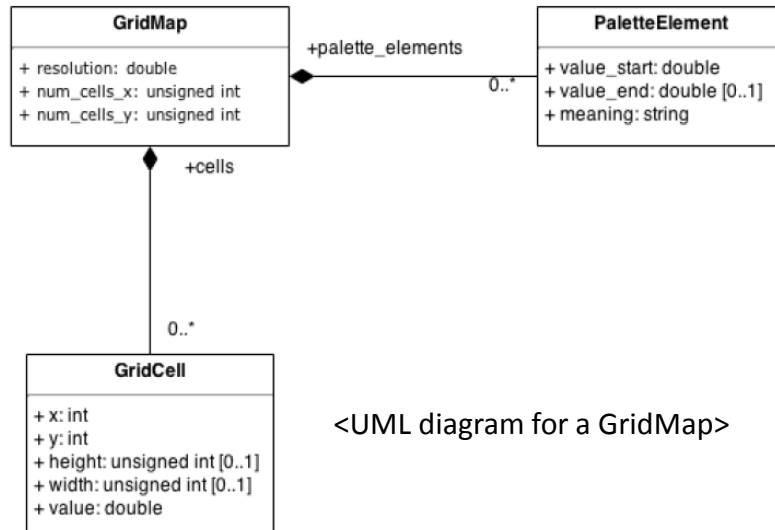


※ Source: 1873-2015 Robot Map Representation for Navigation

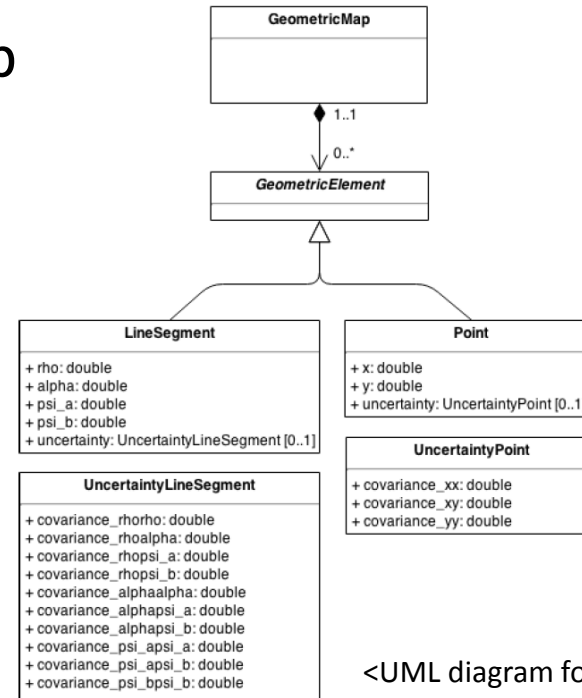
<UML diagram for a LocalMap>

1873-2015 Robot Map Representation for Navigation (3/3)

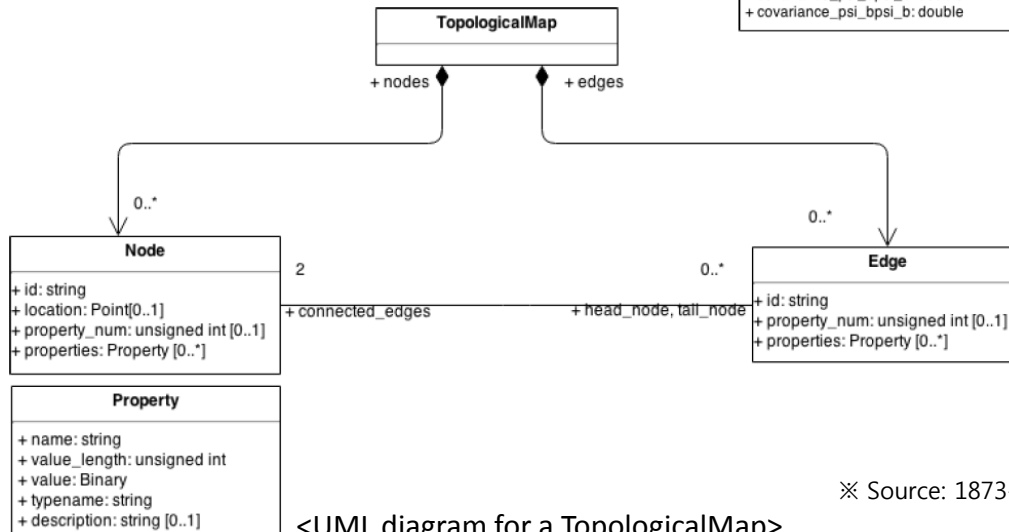
• Grid, Geometric and Topological Map



<UML diagram for a GridMap>



<UML diagram for a GeometricMap>



<UML diagram for a TopologicalMap>

※ Source: 1873-2015 Robot Map Representation for Navigation



ISO TC204 Intelligent Transport System

Intro to ISO TC204 Intelligent Transport System (1/2)

- Scope

Standardization of information, communication and control systems in the field of urban and rural surface transportation, including traveler information, traffic management, public transport, commercial transport, emergency services in ITS field

※ Source: ISO TC204 Homepage

- Homepage

<http://www.iso.org/committee/54706.html>



※ Source: ISO TC204 Report, March 2016.

Intro to ISO TC204 Intelligent Transport System (2/2)

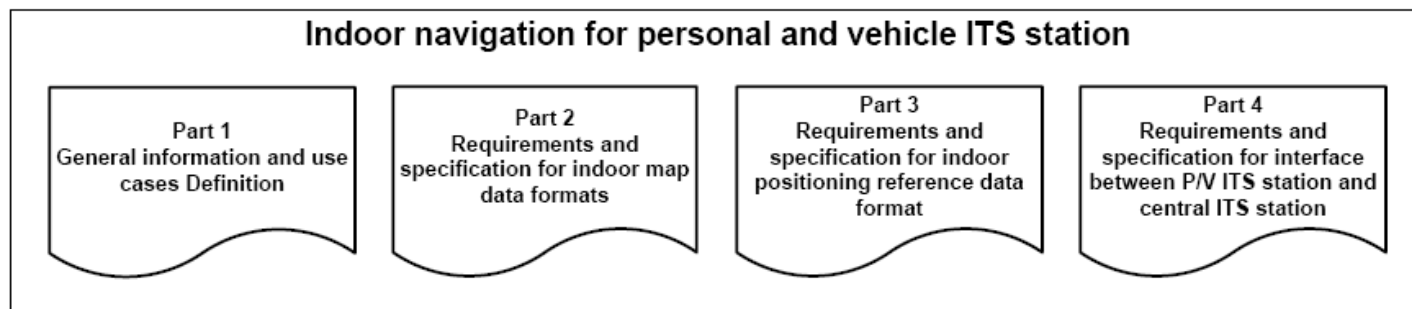
- Working Groups
 - WG1 Architecture
 - WG3 ITS database technology
 - WG4 Automatic vehicle and equipment identification
 - WG5 Fee and toll collection
 - WG7 General fleet management and commercial/freight
 - WG8 Public transport/emergency
 - WG9 Integrated transport information, management and control
 - WG10 Traveller information systems
 - WG14 Vehicle/roadway warning and control systems
 - WG16 Communications
 - WG17 Nomadic Devices in ITS Systems
 - WG18 Cooperative systems

Staple Standards relevant to (indoor or outdoor) map data and navigation

- ISO 14825:2011 ITS – Geographic Data Files (GDF) --- GDF 5.0
 - specifies the conceptual and logical data model and physical encoding formats for geographic databases for ITS applications and services
 - including data dictionaries for features, attributes and relationships
- ISO 17267:2009 ITS – Navigation Systems – Application programming interfaces (API)
 - specifies an application programming interfaces (API) for navigation systems. It specifies data that may be retrieved from map databases, and defines interface for access. It specifies a set function calls
- ISO 17438 ITS – Indoor Navigation for personal and vehicle ITS station
 - specifies the indoor navigation interface, map and positioning reference data format
 - refer to the next page for in-detail
- ISO 24099:2011 ITS – Navigation data delivery structures and protocols
 - defines the data structures and protocol(s) used in ITS applications for the delivery and update of map-related data from service center to users (in-vehicle systems)

ISO 17438 ITS – Indoor Navigation for personal and vehicle ITS Station

- Purpose
 - To Provide service interfaces and specifications for ITS/Telematics applications via nomadic devices to enable the indoor navigation functionality
- Structure
 - Part 1 (17438-1) General information and use cases definitions
 - Part 2 (17438-2) Requirements and specifications for indoor map data formats
 - Part 3 (17438-3) Requirements and specifications for indoor positioning reference data formats
 - Part 4 (17438-4) Requirements and specification for interface between Personal/Vehicle ITS station and Central ITS station



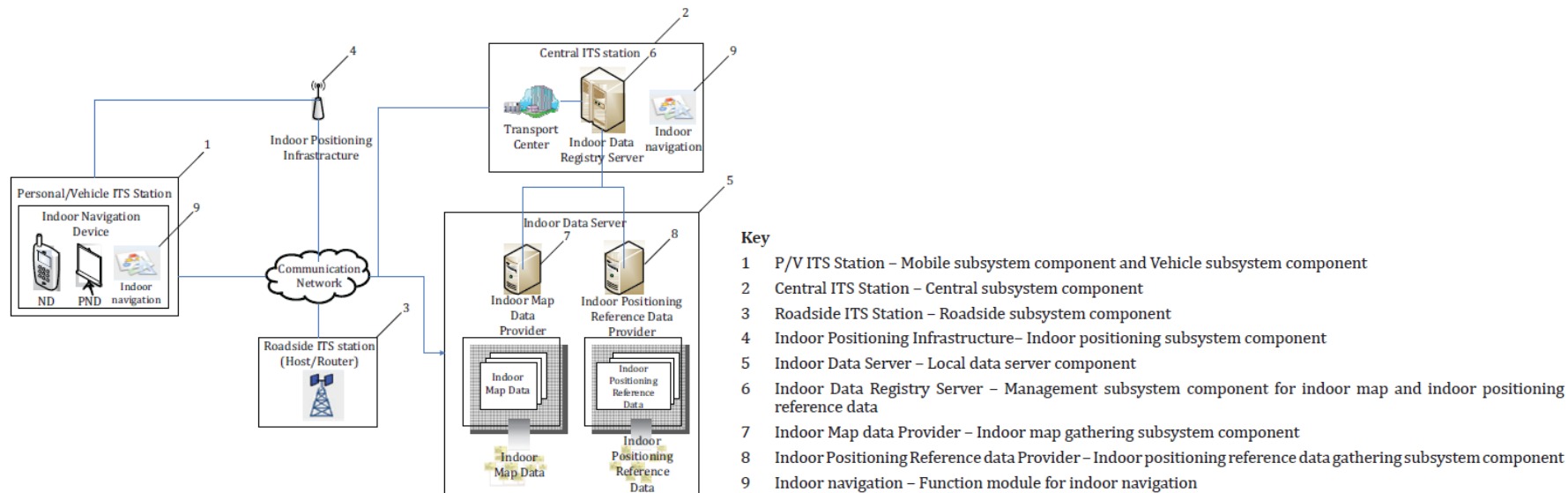
<Structure of ISO 17438 Indoor Navigation for personal and vehicle ITS station>

※ Source: ISO 17438-1

ISO 17438-1 ITS – Indoor Navigation for personal and vehicle ITS Station

- Part 1: General information and use cases definitions

- Scope
 - Specifying the indoor navigation system architecture and use cases in providing indoor navigation to various types of users using personal and vehicle ITS stations
 - Providing a general overview and structure of 17438 series
- Project Leader
 - Mr. Dongkwon Seo, Hyundai M&N Soft
- Overall structure for indoor navigation



※ Source: ISO 17438-1

- Current status
 - Published in 2016

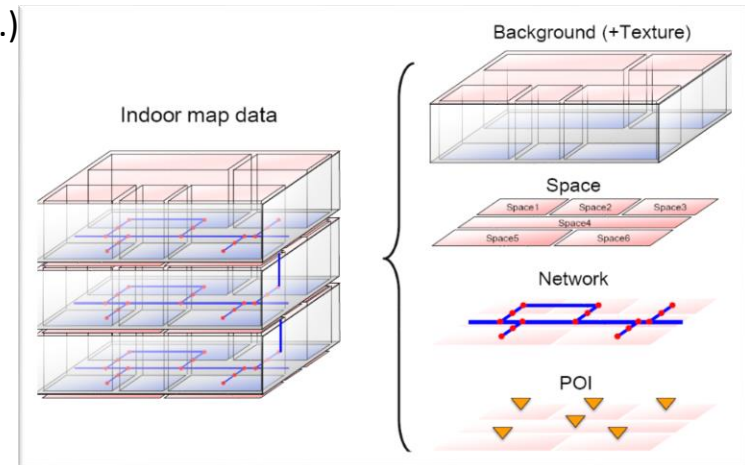
ISO 17438-2 ITS – Indoor Navigation for personal and vehicle ITS Station

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

- Scope
 - Specifying requirements and specification for indoor map data and relevant stuffs considering Personal and vehicle ITS station
 - Possibly, including the followings
 - types and formats for indoor maps
 - packaging various indoor maps, of different indoor spaces (buildings) if needed

※ Types of “(indoor) map” for navigation

- . background map for display & visualization (2D/3D, texture, ...)
- . network (topology) map for routing
- . space (cell) map for semantics of some spaces
 - ex) navigable space, non-navigable space in IndoorGML
- . POI map



- Project Leader
 - N/A
- Current status
 - Current stage is PWI (Preliminary Work Item). There is no full draft yet.
 - Official Proposal (NP, New Proposal) is not yet submitted.
 - Therefore, there is only overall scope and there are no specific contents.
 - Naturally, **OGC IndoorGML** might/can be adopted or referred as indoor network (topology) and space (cell) map formats, according to discussions and future project leader.

ISO 17438-3 ITS – Indoor Navigation for personal and vehicle ITS Station

- Part 3: Requirements and specifications for indoor positioning reference format

- Scope

- Specifying requirements and specification for indoor positioning references and relevant stuffs considering Personal and vehicle ITS station
- Possibly, including the followings
 - types and formats for indoor positioning references
 - packaging various indoor positioning references, if needed

- ✕ Indoor Positioning Reference

Data supporting indoor positioning

ex) WiFi AP List or WiFi fingerprint map for WiFi based positioning

- Project Leader

- N/A

- Current status

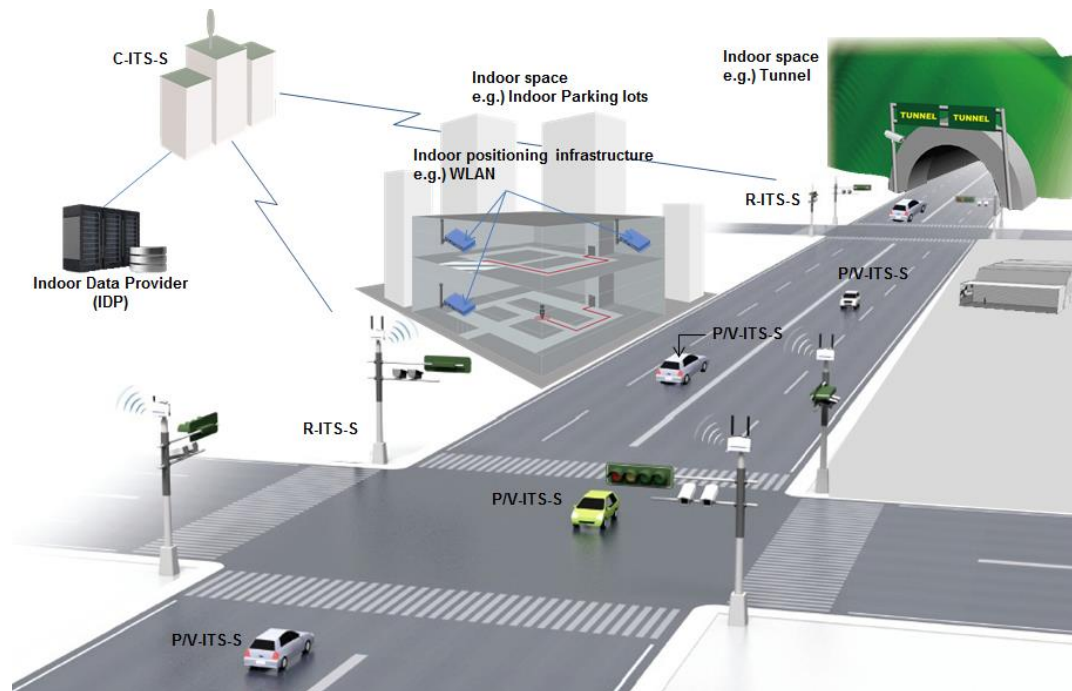
- Current stage is PWI (Preliminary Work Item). There is no full draft yet.
 - Official Proposal (NP, New Proposal) is not yet submitted.
- Therefore, there is only overall scope and there are no specific contents.

ISO 17438-4 ITS – Indoor Navigation for personal and vehicle ITS Station

- Part 4: Requirements and specifications for interface between Personal/Vehicle and Central ITS Station

- Scope

- Specifying requirements and specification for interfaces between Personal/Vehicle and Central ITS station
 - message definitions for searching indoor space and indoor maps on **ITS protocol stack**
 - message definitions for retrieval of information about indoor space and indoor maps
 - . conceptually corresponding to (small) meta-data about spaces and maps.
- **NOT** specifying formats of indoor maps and indoor positioning references itself



<Indoor navigation environment and ITS entities>

※ Source: ISO 17438-4

ISO 17438-4 ITS – Indoor Navigation for personal and vehicle ITS Station

- Part 4: Requirements and specifications for interface between Personal/Vehicle and Central ITS Station

- Document structure (draft)
 - Scope, Normative reference
 - Terms, Definitions, and Symbols
 - Overview of indoor navigation
 - Use-case definitions
 - identification of indoor spaces, search and retrieval of indoor navigation data, indoor positioning, etc.
 - Message definitions
 - definitions of messages for each use-cases
 - Annexes
 - data types, code lists
 - **VIDF** (Vehicle Interface Data Format) and **DXM** (Data eXchange Message) specification for each message definitions based on **ASN.1** (Abstract Syntax Notation).
- Project Leader
 - Ryan, ETRI, South Korea (jjryu@etri.re.kr)
- Current status
 - Currently on CD (Committee Draft) stage.
 - Detailed contents



ISO TC211 Geographic Information

Intro to ISO TC211 Geographic Information

- Scope

Standardization in the field of digital geographic information, specifying methods, tools, and services for geographic data management, acquiring, processing, analyzing, accessing, presenting and transferring geographic information between different users, systems and locations.

※ Source: ISO TC211 Homepage

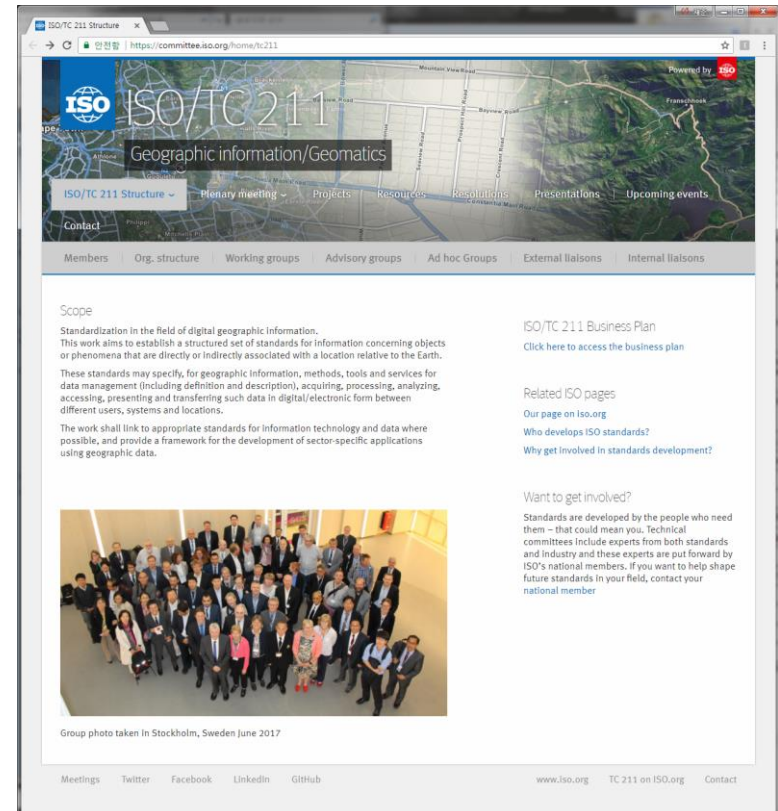
- Homepage

<http://www.iso.org/committee/54904.html>

<https://committee.iso.org/home/tc211>

- Working Groups

- WG1 Framework and reference model
- WG4 Geospatial services
- WG6 Imagery
- WG7 Information communities
- WG9 Information management
- WG10 Ubiquitous public access



Staple Standards relevant to (indoor or outdoor) navigation (not only map)

- ISO 19116:2004 Positioning services
 - specifies the data structures and contents of an interface between position-providing device(s) and position-using devices(s) so that position information can be interpreted unambiguously.
 - in revision phase to include “positioning reliability” concept and “indoor positioning” scheme such as WiFi.
- ISO 19133:2005 LBS – Tracking and navigation
 - describes the data types, and operations associated with those types, for the implementation of tracking and navigation services.
- ISO 19134:2007 LBS – Multimodal routing and navigation
 - specifies the data types and their associated operations for the implementation of multimodal location-based services for routing and navigation.
- ISO 19147:2015 Transfer Nodes
 - specifies the data types and code lists associated with those types for the implementation of transfer nodes and their services in transport modelling and location based services.

※ Potentially, a bunch of ISO TC211 standards can be relevant to navigation according to implementation.



Summary and Implications

• Summary

- Standardization activities probably “directly” relevant to “indoor navigation” (not only map)
 - IEEE RAS P1873 3D Map Data Representations
 - ISO TC204 17438 Indoor navigation for Personal/Vehicle ITS stations
 - ISO TC211 19116 Positioning services, ...
- There are several standards relevant to “outdoor navigation” (not only map) in ISO TC204 & TC211

• Implications

- There may exist matching points between indoor standards and outdoor standards
- Comparison and analysis of the indoor and outdoor standards may provide some directions of next standardization activities for indoor “map” and navigation
 - ✂ *Need to check and to keep in mind what makes the difference between indoor and outdoor map (also navigation)*