A Framework for Gap analysis of Geospatial Standards for Smart Cities

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I. Introduction

Basic Process for GAP Analysis

- What Do we need to Do to Get there?
- Where are we now?
- Gap Analysis
- How Do we do that?
- Desired State
- Where Do we want to go?
- Current State
I. Introduction

Gap Analysis Methodology

- Methodologies for **analyzing and mapping user requirement** from different level of perspectives
- **Standardization needs** of a more detailed model to identify the **potential requirements**

[Steps in the data specification cycle]

- Use case development
- Identification of user requirements and spatial object types
- Gap analysis
- Data specification development
- Implementation, testing and validation
- Maintenance

[Three dimensional model mapping for potential requirement of smart city]

[Reference Architectural Model Industrie 4.0 (RAMI 4.0)]
Need to discuss gap analysis framework for mapping requirements of different smart city domains in the context of geospatial information standards.
I. Introduction

**Gap Analysis Methodology**

- Identify user requirement and standard gap (current state) to implement smart city reference model (desired state)

**Use Case Development (ISO 19119:2016)**

- **As-Is** Current State
  - Project Planning: create project space
  - Use Case Identification: create UC entry
  - Use Case Discussion: read/write UC entry
  - Use Case Model Spec.: specify UC in UML
  - Agreement?:
  - Information Model Spec.: specify requested resources

- **To-Be** Desired State
  - Elected Officials
  - Municipal Employees
  - Public
  - Application Layer:
    - Health
    - Intelligent buildings
    - Intelligent transportation
    - Open data
    - Public safety and security
    - Environmental Protection
    - Urban planning
  - Business Layer:
    - Analytics and Models
    - Visualization and Decision Support (Simulation, Prediction)
    - Catalogs, Semantics
    - Business services
  - Data Access:
    - Urban/Municipal Database
    - Cloud hosted resources
  - Security Systems

**Use Case Scenario**

[Analysis phase of the SERVUS Methodology]
II. Gap Analysis Framework

Gap Analysis Framework for Smart City in Geospatial Context

- Interoperability levels (ISO 19101-1) increase vertically for greater exchange of meanings, which correspond to multi-layers in smart city reference model (Z-axis)

![Diagram showing the levels of interoperability and their corresponding layers in a smart city reference model.](image)
II. Gap Analysis Framework

Gap Analysis Framework for Smart City in Geospatial Context

- Mapping Geospatial data life cycle and example of applicable standards to smart city reference model (Y-axis)

[Geospatial Data Life Cycle]

Applicable Standards

- ISO 19115-1 (data and services metadata), W3C DCATv2 for semantic web metadata capturing, ISO 19110 (methodology for feature cataloguing), OGC Geopackage (format for transferring)
- ISO 19157-3 (data quality), PROV to record history of data changers
- OGC O&M / ISO 19156 (data observations and measurements)
- ISO 19165-1 and ISO 19165-2 (digital data preservation), and PROV to record history of data changers
- ISO 19157-2 (data quality), OGC O&M / ISO 19156 (data observations and measurements)
- ISO 19109 (rules for application schema), ISO 19131 (Data product specifications), ISO 19115-1 (data and services metadata), W3C DCATv2 for semantic web metadata capturing

Source: Integrated Geospatial Information Framework: Strategic Pathway 4-Data
II. Gap Analysis Framework

Gap Analysis Framework for Smart City in Geospatial Context

- Align and coordinate user requirement and applicable standards identified from level of interoperability and geospatial data life cycle to each layers of smart city reference model.
### III. Gap Analysis of Indoor-outdoor Seamless Navigation

#### Gap Analysis Process

- Gap analysis can be divided into 6 phases of use case mapping process in terms of 6 interoperability layers and smart city reference model.

#### Use Case Scenario for indoor-outdoor seamless navigation (ISO 17438-1)

**Use case mapping process to Smart City Reference Model**

5 December 2022
ISO/TC 211 Geographic information/Geomatics
### III. Gap Analysis of Indoor-outdoor Seamless Navigation

#### 1. Use Case Analysis

- Apply use case scenario (ISO 17438-4) for indoor-outdoor seamless navigation

<table>
<thead>
<tr>
<th>#</th>
<th>Title of use case cluster</th>
<th>Brief description</th>
<th>Related use cases in ISO 17438-1</th>
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<tbody>
<tr>
<td>1</td>
<td>Identification of Indoor spaces</td>
<td>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</td>
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<td>2</td>
<td>Search and retrieval of Indoor navigation data</td>
<td>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</td>
<td>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</td>
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<td>3</td>
<td>Client based indoor navigation</td>
<td>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</td>
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III. Gap Analysis of Indoor-outdoor Seamless Navigation

Development of Component Layer

- The content of the component layer is derived from the use case information on indoor navigation architecture (ISO 17438-1:2016)

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
Ⅲ. Gap Analysis of Indoor-outdoor Seamless Navigation

3 Development of Business Layer

- The business layer shows the area which is affected by the use case and consequently influenced by underlying **business objectives** and **economic and regulatory constraints**.*

* Objectives and constraints need to be taken into account as non-functional requirements for implementations.
### III. Gap Analysis of Indoor-outdoor Seamless Navigation

#### 4. Development of Function / Service Layer

- Mapping phases of use case scenario (ISO 17438-4) to units of the component layer derived from the indoor navigation architecture (ISO 17438-1:2016)

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[ Use Case Scenario (ISO 17438-4) ]
Ⅲ. Gap Analysis of Indoor-outdoor Seamless Navigation

5 Development of Information Layer

- Mapping phases of use case scenario (ISO 17438-4) to relevant phases of geospatial data life cycle in which applicable geospatial standards can be identified

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[ Use Case Scenario (ISO 17438-4) ]

[ Geospatial Data Life Cycle ]

Applicable Standards

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- ISO 19109 (rules for application schema), ISO 19131 (data product specifications), ISO 17438-1 (data and services metadata), W3C DCATv2 for semantic web metadata capturing
The communication layer is to describe protocols and mechanisms for the interoperable exchange of information between the use case scenario considering the groups of communication networks and wireless technologies for IoT by geospatial coverage range.

II. Gap Analysis of Indoor-outdoor Seamless Navigation

Component Layer “Units of Indoor Navigation Architecture”
Ⅳ. What’s Next

Step by step approach

- Needs to collaborate for discussing user requirement and identifying applicable standards and gaps to implement indoor-outdoor seamless navigation in the context of smart city reference model

Phase of Collaboration
- Write and Share TR
  - Identify and share common interest between different domains
- Joint Work Shop
  - Develop common use case and service scenario
- Joint Project
  - Create test-bed and develop pilot project
- Joint Working Group
  - Make standards for specified common interests
THANK YOU

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