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# Geographic information — Indoor feature model

*Information géographique — Modèle d'entités intérieures*



FDIS stage



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## Contents

## Foreword

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This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Geographic Information,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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

Various location-based indoor applications, such as indoor navigation, indoor car parking and indoor emergency response, are increasingly involved in daily lives and ~~managements~~the management of public buildings. These applications need information on indoor features (such as floors, rooms, doors and windows) and their spatial associations to describe the environment inside a building. Accordingly, many application systems and related standards have been developed in recent years.

OGC CityGML 3.0~~[4]~~[4] is designed as a universal information model that defines object types and attributes which are useful for a broad range of applications. For the building model, CityGML focuses on the semantic definitions of buildings and their parts (e.g. walls, roofs, dormers, doors, windows, etc.) and the representation of the relations between those features. However, CityGML does not specify strict rules as to which semantic objects have to be included in a specific Level of Detail (LoD) model~~.[7]~~.[7] Although the CityGML model can be extended by the Application Domain Extension (ADE) mechanism by adding new object types or new properties for specific applications, it is possible to specify different ADEs for different information communities~~ and every~~. Every ADE may add their specific properties to the same CityGML feature type as they can all ~~can~~ belong to the same substitution group~~.[6]~~.[6] These CityGML feature types can also have the problem of semantic heterogeneity in sharing and intergrading datasets.

OGC IndoorGML 1.1~~ standard~~[4] defines the representation and exchange of indoor navigation network models. It aims to establish a common schema for indoor navigation applications by modelling the topology and semantics of indoor spaces, which are needed for the components of navigation networks~~ [2] .~~.[2] An IndoorGML document contains external links to referenced objects specified in other data sets such as CityGML and IFC (Industry Foundation Classes), where the objects in the external data set include geometric information~~.[2]~~.[2]

The Industry Foundation Classes (IFC) (ISO 16739-1~~:2018~~), an open international standard for Building Information Model (BIM) data, provide detailed 3D geometries and rich semantics to describe architectural components and engineering constructions of buildings. IFC aims to cover the whole project lifecycle, i.e. the "plan", "design", "construct", "operate" and "maintain" phases of buildings with more than 600 classes in different categories. However, IFCs contain too much architectural information and are too complex to be used in their current format for indoor emergency situations~~.[11]~~.[11] It is not necessary to use all these classes for a specific application such as indoor navigation~~.[9]~~.[9] However, some information on the architectural components and engineering constructions of buildings defined in IFC can be extracted to describe the attributes of indoor features used in location-based indoor applications to describe indoor spatial environments to help people to implement their works or plans efficiently.



ISO/TS 19166 provides a conceptual framework for mapping BIM to Geographic Information Systems (GIS) with three mapping mechanisms, Perspective Definition (B2GPD), Element Mapping (B2GEM) and LOD Mapping (B2GLM). It focuses on the definition of BIM to GIS conceptual mapping requirements and framework without a bi-directional mapping method and the definition of physical schema. It cannot be used directly to guide which indoor features are to be extracted from BIM to describe indoor environments for location-based indoor applications. Different information communities can set different rules for the mapping from BIM to GIS and then produce GIS databases with different indoor features for the same building. This would make ~~these~~the sharing and integration of databases ~~hard to be shared and integrated~~difficult.

OGC Indoor Mapping Data Format (IMDF~~)[5]~~)[5] provides a generalized, yet comprehensive model for any indoor location, providing a basis for orientation, navigation and discovery (19-089r1). IMDF mainly focuses on the contents of individual indoor features related to navigation issues and does not define a general structure of these indoor elements to cover the relationship between indoor spaces or features.

Therefore, a relatively independent and concise indoor feature model is needed for describing the required features of an indoor spatial environment for location-based indoor applications such as indoor navigation, indoor addressing, indoor car parking and indoor emergency response. This model could provide a common reference to guide the collection and organization of indoor spatial information, and serve as the foundation of a conceptual model for data mapping and sharing among various application systems.

This document defines such an indoor feature model by following the rules of application schema defined in ISO 19109. A dataset compliant with this document can serve as the common basic database in various location-based (LBS) indoor applications and facilitate data sharing and integrating among different platforms or applications. This document ~~would~~can be beneficial ~~to reduce~~in reducing the overlapping efforts in the production of the basic database of buildings, and it ~~would~~can also be useful ~~to~~in the transfer of indoor-application platforms or systems with little adjustments from one building to another building based on the common basic database. The intention is for various stakeholders (including indoor data producers and users of location-based indoor application systems) to have a unified understanding of these features for ~~unambiguously retrieving~~the unambiguous retrieval of information.

Based on this document, a series of profiles can be specified for various location-based indoor applications~~,~~ for example, a profile for indoor navigation or way-finding by linking with a geometric and topological relationship specified in IndoorGML, or a profile for a fire emergency by adding the features related to firefighting emergency utilities.

This document provides two informative annexes to present the class-level referenced relationship between the Indoor Feature Model and BuildingModel of CityGML 3.0, IFC of ISO 16739~~:2018~~-1 and IndoorGML.

# Geographic information~~ – ~~ — Indoor feature model

## 1 Scope

This document specifies a core semantic classification system of essential indoor features to describe indoor environments required commonly in various location-based indoor applications of buildings. The scope includes the following:

— ~~—~~ semantic description of indoor features and their attributes;

— ~~—~~ feature association between indoor features.

The semantic classification system in this document is compatible with the building model defined in existing ~~relative~~related standards. Geometric and topological descriptions of indoor features are not considered in this document. This document does not apply to other architectural structures, such as tunnels.

## 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.

ISO 19103, *Geographic information — Conceptual schema language*

~~ISO 19107, *Geographic information — Spatial schema*~~

~~ISO 19108, *Geographic information — Temporal schema*~~

ISO 19109, *Geographic information — Rules for application schema*

ISO 19115-1, *Geographic information — Metadata — Part 1: Fundamentals*

ISO 16739-1, *Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries — Part 1: Data schema*

ISO 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*



## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

— ~~—~~ IEC Electropedia: available at ~~https://www.electropedia.org/~~https://www.electropedia.org/

**3.1**
**feature**
abstraction of real-world phenomena

Note~~-~~ 1~~-~~ to~~-~~ entry:~~-~~ A feature can occur as a type or an instance. Feature type or feature instance will be used when only one is meant.

[SOURCE: ISO 19101-1:2014, 4.1.11]

**3.2**
**feature attribute**
characteristic of a *feature* ~~(3.1)~~(3.1)

Note~~-~~ 1~~-~~ to~~-~~ entry:~~-~~ A feature attribute has a name, a data type, and a value domain associated to it. A feature attribute for a feature instance also has an attribute value taken from the value domain.

[SOURCE: ISO 19101-1:2014, 4.1.12, modified — Examples 1 and 2 along with Notes 2 and 3 have been ~~deleted~~removed.]

**3.3**
**feature association**
~~the~~ relationship that links instances of one *feature* ~~(3.1) type~~*type* (3.4) with instances of the same or a different feature type ~~(3.4)~~

[SOURCE: ISO 19110:2016, 3.3]

**3.4**
**feature type**
class of *features* (3.1) having common characteristics

[SOURCE: ISO 19156:2023, 3.9]



**3.5**
**indoor entity feature**
*feature* ~~(3.1)~~(3.1) constructed as indoor architectural components or features attached for a specific use inside a building



EXAMPLE Windows, doors, furniture~~,~~ and facilities are indoor entity features.

**3.6**
**indoor space feature**
*feature* ~~(3.1)~~(3.1) that ~~contain~~contains *indoor entity features* ~~(3.5) and/~~(3.5) or is used as a place for a specific purpose inside a building, or both

EXAMPLE Rooms, balconies~~,~~ and pathways are indoor space features.

**3.7**
**indoor map**
portrayal of an *indoor entity feature* (3.5) and *indoor space features* (3.6) as a digital image or vector file suitable for display on a computer screen

# 4 Symbols and abbreviated terms

## ~~1.1~~4.1 Abbreviated terms

BIM ~~Building Information Modelling~~building information model

IFC ~~Industry Foundation Classes~~industry foundation classes

IFM ~~Indoor Feature Model~~indoor feature model

GML ~~Geography Markup Language~~geography markup language

HMMG Harmonized Model Maintenance Group

LBS ~~Location-Based Service~~location-based service

OGC Open Geospatial Consortium

UML ~~Unified Modelling Language~~unified modelling language

URI ~~Uniform Resource Identifier~~uniform resource identifier

### ~~1.2~~4.2 UML notation

In this document, conceptual schemas are presented in the ~~Unified Modelling Language~~unified modelling language (UML). The specific profile of UML used in this document is presented in ISO 19103.

## 5 Conformance

This document defines one conformance class:

— ~~—~~"Indoor Feature Model" (specification target: Indoor Feature Model);

A specification, standard, test suite~~,~~ or test tool claiming conformance to this document shall implement the conformance class relevant to that specification target.

Conformance with this document shall be assessed using all the relevant conformance test cases specified in ~~Annex A~~Annex A of this document.

All requirements specified in this document belong to the Indoor Feature Model requirements class, which is identified by the URI ~~https://standards.isotc211.org/19164/-1/req/IndoorFeatureModel~~https://standards.isotc211.org/19164/-1/req/IndoorFeatureModel.

Identifiers of requirements and conformance tests specified in this document are relative to ~~https://standards.isotc211.org/19164/-1~~https://standards.isotc211.org/19164/-1.

The name and contact information of the maintenance agency for this document can be found at ~~www.iso.org/maintenance_agencies.~~www.iso.org/maintenance_agencies.

## 6 General

The Indoor Feature Model (IFM) defines a unified structure and description of the generic indoor features which can be understood consistently by users (including indoor data producers, developers and users of location-based indoor applications). The generic indoor features are the basic components constructing the spatial environments inside a building, and the feature attributes and feature associations provide information about these components. One of the applications of IFM is to provide the spatial information to make an indoor map to represent the spatial layouts of these basic components and their characteristics visually.



 

## 7 Relationship with the existing International Standards

Figure 1Figure 1 illustrates the relationship between IFM defined in this document and other International Standards related to indoor data and application schema. This document follows the rules of application schema defined in ISO 19109. The conceptual schema is presented in UML in conformance with ISO 19103 and refers to. The data types defined intype definitions from ISO 19103 and ISO 19115-1 apply.

IFM refers to relative classes and enumerations defined in ISO 16739-1 (IFC) and CityGML and takes IndoorGML, CityGML and IFC as the external data sources of topological and geometric information of IFM.






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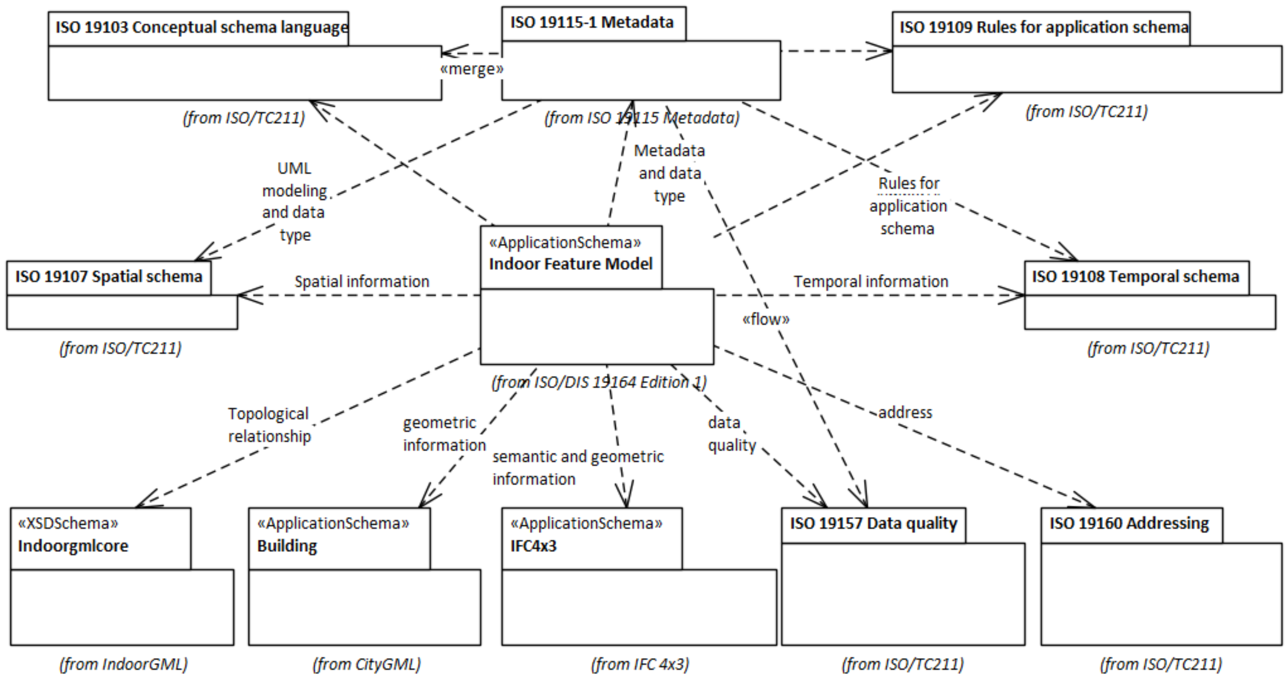




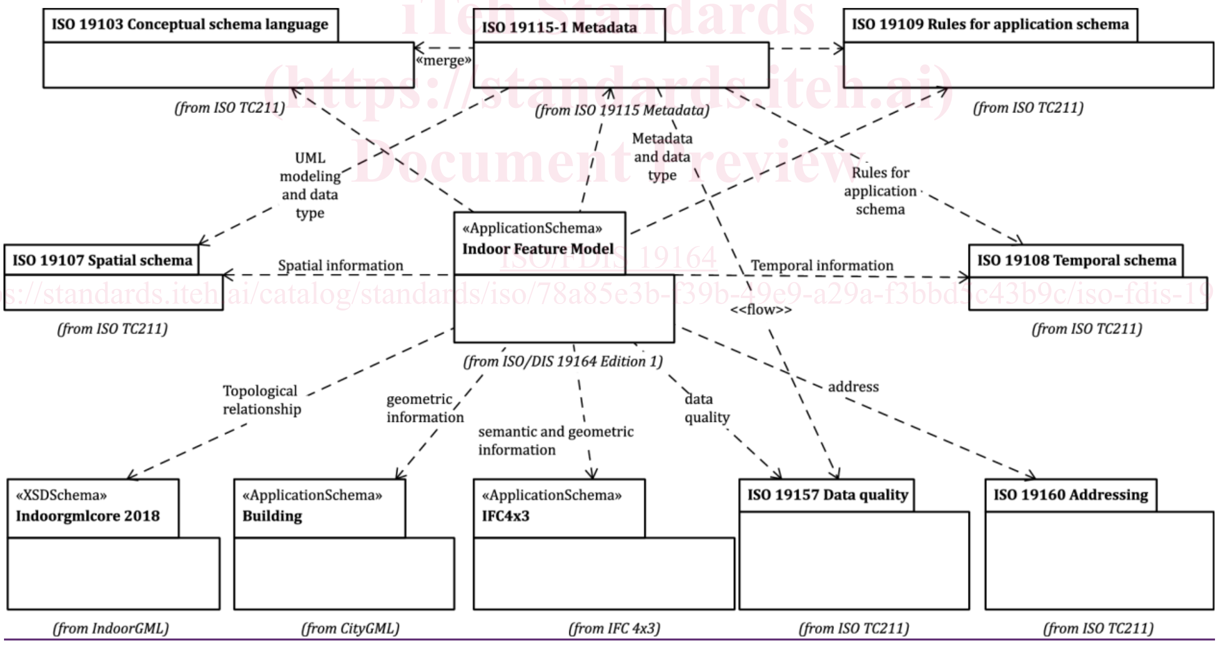
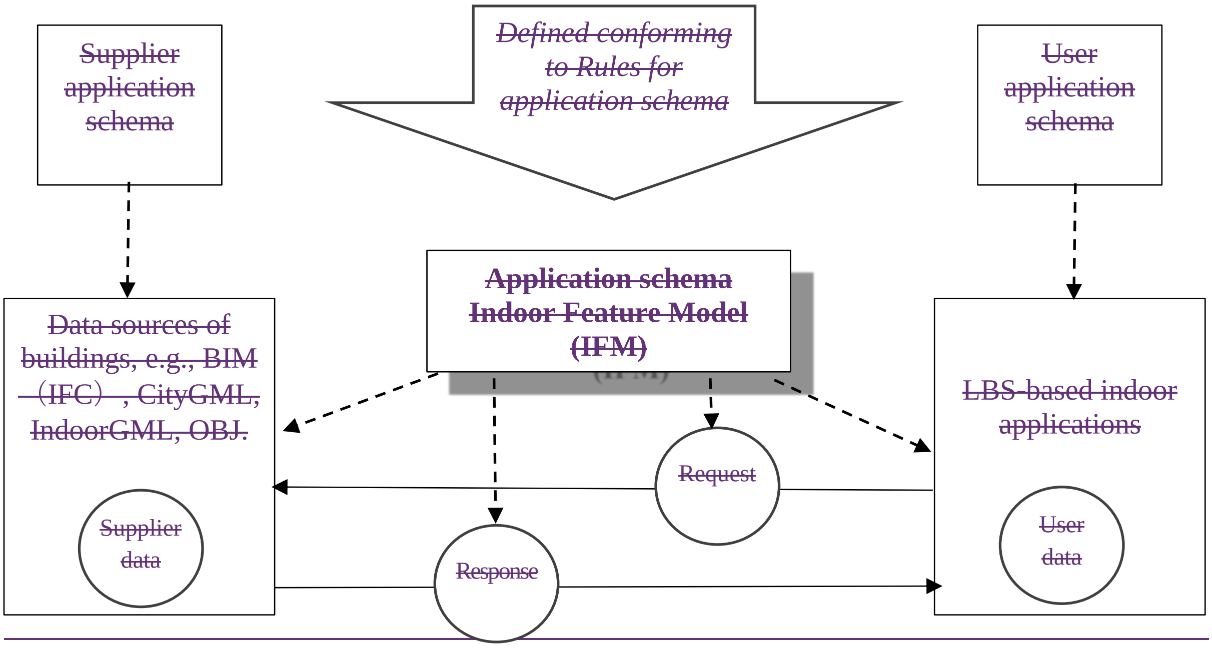
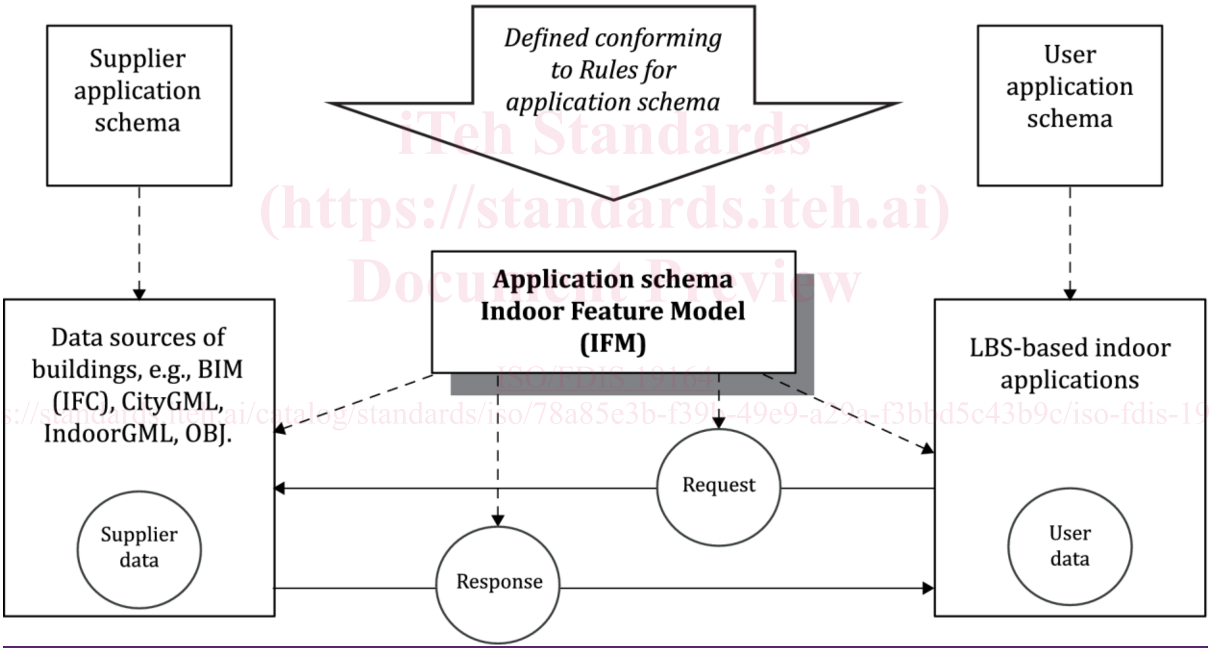




**Figure 1 1 — Relationship with ISO and OGC standards**

Following the rules of the application pattern defined in ISO 19109 on data interchange, Figure 2Figure 2 shows the role of IFM in data interchange between supplier data sources and user data sources related to LBS-based applications.






NOTE Modified from ISO 19109:2015. The unbroken lines show the flow of data. Broken lines denote the role of the application schema on the data interchange.

**Figure ~~2~~ 2 — The role of IFM on data interchange**

# 8 Indoor Feature Model

## ~~1.3~~8.1 Indoor top features

IFM defines the semantic structure of a minimal set of the generic feature types, feature attributes and feature associations of a building, especially a large public building or office building, with complex structures, multiple functions and diverse public users ~~(Figure 3).~~(Figure 3). These generic feature types should be