INTERNATIONAL STANDARD

ISO 19155

First edition
2012-11-01

Geographic information — Place Identifier (PI) architecture

Information géographique — Architecture d'identifiants de lieu (IL)

Reference number
ISO 19155:2012(E)

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 19155 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

The rapid development of information technology has blurred the boundaries between the real and virtual worlds in such a way that they cannot easily be disassociated from each other. Humans can reference places in both worlds and easily differentiate between them. However for computers to clearly differentiate these places, a set of matched linkages between them are required.

In the discipline of geography, space normally refers to the surface of the earth. However, in other disciplines, space can refer to different paradigms. In architecture, space may be the extent of a room or a building. In mathematics, space is defined as a set having structure. In the context of the World Wide Web space is defined by URLs/URIs that identify web pages.

Within this International Standard "space" is considered as a set having structure, in which a position or location identifies an element.

Currently, within the domain of ISO/TC 211, standards exist for precise positioning and locating using either coordinates or geographic identifiers. However, the concept of place is broader than both position and location. A "place" is referred to as a "position" when that place is identified using coordinates. Similarly, a "place" is referred to as a "location" when that place is identified using geographic identifiers. However, existing standards defined by ISO/TC 211 do not provide a mechanism for the representation of a virtual "place" such as a website, or a construct acting as a "common base" which can be used to refer to the other types of identifiers.

Within this International Standard, "place" is defined as an identifiable part of any space. This may include "places" existing not only in the real world but also those in the virtual world. Places are identified using either "position" by coordinates, "location" by geographic identifiers, or "virtual world identifiers" such as a URI.

In this International Standard, the identifier of a place is referred to as a Place Identifier (PI). A single "place" may be identified using several separate Place Identifiers. Clarification of these relationships is shown in Figure 1.

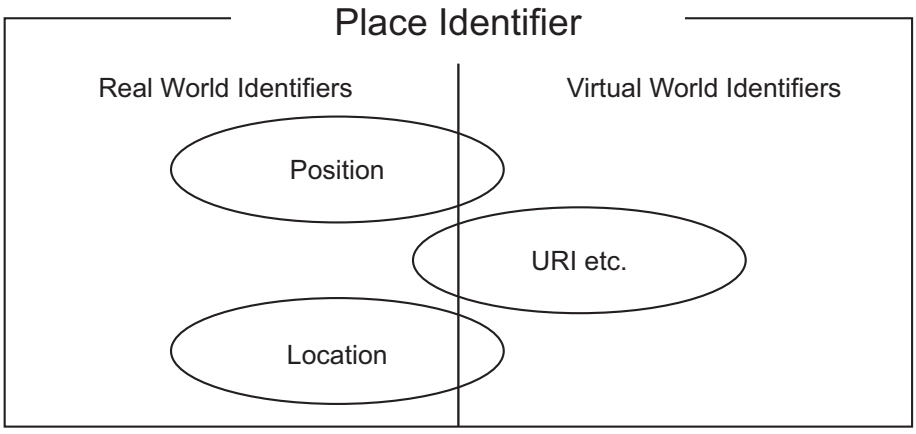

Figure 1 — Relationships among place, position, location and URI

Place descriptions are used for information retrieval. In reality, those identifiers often refer to the same place. Currently these relationships are difficult for machines to correctly distinguish, which impedes the discovery and retrieval of information. The conceptual architecture and reference model defined in this International Standard provides a mechanism for solving these problems.

When implemented, this architecture would enable the access and sharing of place descriptions using the Place Identifier as the standardized method.

Within the reference model, place descriptions are defined using a PI. A PI consists of a reference system (RS), a value, and the valid temporal period of that value.

The internal format and content of the value are determined by each community or domain. The content of the values are not subject to any kind of standardization or unification by this International Standard. The RS is also defined by each community, and should be unique across multiple communities. Subsequently, Place Identifiers are unique within each RS. However, the values of the Place Identifiers may be similar or even identical across multiple communities. This distributed concept ensures that each community would maintain their own Place Identifiers. Well formed Place Identifiers may be shared between communities.

Instead of specifying a framework for a globally unique type of identifier, the key idea of the architecture defined in this International Standard enables the original place descriptions to be easily maintained, without requiring difficult conversions and cross-community harmonization.

An encoding scheme based on Geography Markup Language (GML) (ISO 19136:2007) is normatively defined in this International Standard. In addition, a group of alternate encoding schemes are presented as informative annexes. Depending on the encoding method of choice, globally unique Place Identifiers may be created resulting from the requirements of the encoding method used.

Methods for the conversion of "located features" to Place Identifiers are not covered within the scope of this International Standard. While the direct relationship with the PI Architecture and other Spatial Data Infrastructures (SDIs) is not explained, an implementation of the PI Architecture can be considered part of an SDI. Various constructs, such as registries and databases, may be used to store Place Identifiers. The flexible structure of the Place Identifier will allow for data stored in common GI systems to be easily registered as Place Identifiers, however, the design and implementation of those procedures is out of scope of this International Standard.

Geographic information — Place Identifier (PI) architecture

1 Scope

This International Standard specifies an architecture that defines a reference model with an encoding method for an identifier of a place. The concept of "place" within this International Standard includes "places" not only in the real world but also those in the virtual world. These "places" are identified using either coordinate identifiers, geographic identifiers, or virtual world identifiers such as URI. In this International Standard, an identifier of a place is referred to as a Place Identifier (PI).

The reference model defines a mechanism to match multiple Place Identifiers to the same place. In addition, a data structure and set of service interfaces are also defined in this reference model.

This International Standard is applicable to location based services, emergency management services and other application domains that require a common architecture, across specific domains, for the representation of place descriptions using coordinate, geographic, or virtual world identifiers.

This International Standard is not about producing any kind of specific place description, nor about defining a unique, standardized description of defined places, such as an address coding scheme.

2 Conformance

2.1 Conformance clause

This International Standard specifies four conformance classes. The following conformance clauses should be followed in order to meet the requirements of this International Standard.

2.2 Conformance tests for Semantics

To conform to this International Standard, instances of PI_PlaceIdentifier, PI_ReferenceSystem, PI_MatchingTable, and PI_MatchedPISet shall satisfy the requirements of A.1.

2.3 Conformance tests for Data

To conform to this International Standard, data stored in the PI matching table and the reference system shall satisfy the requirements of A.2.

2.4 Conformance tests for Services

To conform to this International Standard, interfaces between services and users that the PI matching service and the reference system service implement shall satisfy the requirements of A.3.

2.5 Conformance tests for PI encoding

To conform to this International Standard, encoded instances of PI_PlaceIdentifier shall satisfy the requirements of A.4.

3 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/TS 19103:2005, *Geographic Information — Conceptual schema language*

ISO 19111:2007, *Geographic information — Spatial referencing by coordinates*

ISO 19112:2003, *Geographic information — Spatial referencing by geographic identifiers*

ISO 19136:2007, *Geographic information — Geography Markup Language*

4 Terms and definitions

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

4.1
client
software component that can invoke an operation from a *server* (4.16)

[ISO 19128:2005, 4.1]

4.2
coordinate
one of a sequence of *n* numbers designating the position of a point in *n*-dimensional space

[ISO 19111:2007, 4.5]

NOTE In a *coordinate reference system* (4.4), the coordinate numbers are qualified by units.

4.3
coordinate operation
change of *coordinates* (4.2), based on a one-to-one relationship, from one *coordinate reference system* (4.4) to another

[ISO 19111:2007, 4.7]

NOTE Supertype of coordinate transformation and coordinate conversion.

4.4
coordinate reference system
coordinate (4.2) system that is related to an object by a datum

[ISO 19111:2007, 4.8]

NOTE For geodetic and vertical datums, the object will be the Earth.

4.5
gazetteer
directory of instances of a class or classes of features containing some information regarding position

[ISO 19112:2003, 4.2]

NOTE The positional information need not be *coordinates* (4.2), but could be descriptive.

4.6
geographic identifier
spatial reference (4.19) in the form of a label or code that identifies a location

[ISO 19112:2003, 4.3]

EXAMPLE ‘Spain’ is an example of a country name; ‘SW1P 3AD’ is an example of a postcode.

4.7
interface
named set of operations that characterize the behaviour of an entity

[ISO 19119:2005, 4.2]

4.8
place
identifiable part of any space

4.9
Place Identifier
PI
reference that identifies a *place* (4.8)

NOTE The same *place* may be referenced by multiple *Place Identifier* (4.9) instances. Each instance will be associated with a different reference system.

4.10
Place Identifier application
PI application
application providing *services* (4.17) that use *Place Identifiers* (4.9) to end *users* (4.21) or other applications

4.11
Place Identifier matching
PI matching
matching of a *Place Identifier* (4.9) specifying a *place* (4.8) with another type of PI identifying the same place

NOTE 1 A source PI can be matched with multiple target *Place Identifiers*.

NOTE 2 *PI matching* (4.11) can be made among *coordinates* (4.2), *geographic identifiers* (4.6) and identifiers in the virtual world such as URI.

4.12
Place Identifier platform
PI platform
group of *service* (4.17) *interfaces* (4.7) and data structures used for *PI matching* (4.11)

4.13
registration
assignment of a permanent, unique, and unambiguous identifier to an item

[ISO 19135:2005, 4.1.12]

4.14
request
invocation of an operation by a *client* (4.1)

[ISO 19128:2005, 4.10]

4.15
response
result of an operation returned from a *server* (4.16) to a *client* (4.1)

[ISO 19128:2005, 4.11]

4.16
server
particular instance of a *service* (4.17)

[ISO 19128:2005, 4.12]

4.17
service
distinct part of the functionality that is provided by an entity through *interfaces* (4.7)

[ISO 19119:2005, 4.1]

4.18
service metadata
metadata describing the operations and geographic information available at a *server* (4.16)

[ISO 19128:2005, 4.14]

4.19
spatial reference
description of position in the real world

[ISO 19111:2007, 4.43]

NOTE This may take the form of a label, code or *coordinate* (4.2) tuple.

4.20
spatial reference system
system for identifying position in the real world

[ISO 19112:2003, 4.6]

4.21
user
active object that initiates *service* (4.17) *requests* (4.14) to the system

[ISO 19132:2007, 4.58]

NOTE 1 Users are usually objects that act as proxies for people accessing the functionality of the system.

NOTE 2 These objects can be a *PI application* (4.10) or creators of *PI matching* (4.11) tables and reference systems.

5 Abbreviated terms and notation

5.1 Abbreviated terms

CRS Coordinate Reference System

HTTP Hypertext Transfer Protocol

PI Place Identifier

SRS Spatial Reference System

UML Unified Modelling Language

URI Uniform Resource Identifier

URL Uniform Resource Locator

XML eXtensible Markup Language

5.2 UML Notation

The UML notation used in this International Standard is specified in ISO/TS 19103:2005.

6 PI Reference Model

6.1 Background

Place may be understood as an element in any space, in either the real or virtual world. The Oxford English Dictionary defines "place," relevant to the content of this International Standard, with the following entries:

— a particular position or point in space,

— a portion of space occupied by someone,

— a position in a sequence, in particular,

— [in place names] a square or short street.

In this International Standard space is considered as a set having structure, in which a position or location identifies an element. Position is a place typically described by a point or geometry in a space. Location is a place typically described by a geographic identifier such as a street address, postcode, name of a landmark, etc.

"Place" in this International Standard is defined as an identifiable part of any space. This may include "places" existing not only in the real world but also those in the virtual world. This International Standard defines an identifier for a place which is referred to as a "Place Identifier (PI)."

The same place may be identified with multiple Place Identifiers. If the place is identified with coordinates, it is called "position" and if the place is identified with geographic identifiers, it is called "location". Additionally, the place may be identified with online resource identifiers such us URI.

In the General Feature Model of ISO 19109:2005, "position" is a spatial attribute of a feature, "location" is a location attribute of a feature, and a virtual identifier, such as a URI, is a thematic attribute of a feature. Therefore, a PI can be considered as an attribute of a feature.

Humans can more easily see the relationships where those identifiers refer to the same place, yet those relationships are more difficult for machines to distinguish correctly. This difficulty impedes the discovery and retrieval of information. Matching of Place Identifiers enables humans to access information using those Place Identifiers as retrieval keys.

This International Standard defines a reference model in which a method for matching between Place Identifiers is defined. This matching method is shown in Figure 2. Parts of the matching method are already defined in other International Standards. ISO 19111:2007 defines coordinate operations in matching with position. ISO 19112:2003 defines a gazetteer schema that enables matching between location and position. The reference model defined in this International Standard shall conform to previous standards (ISO 19111:2007 and ISO 19112:2003), and further enables the matching between different Place Identifiers.

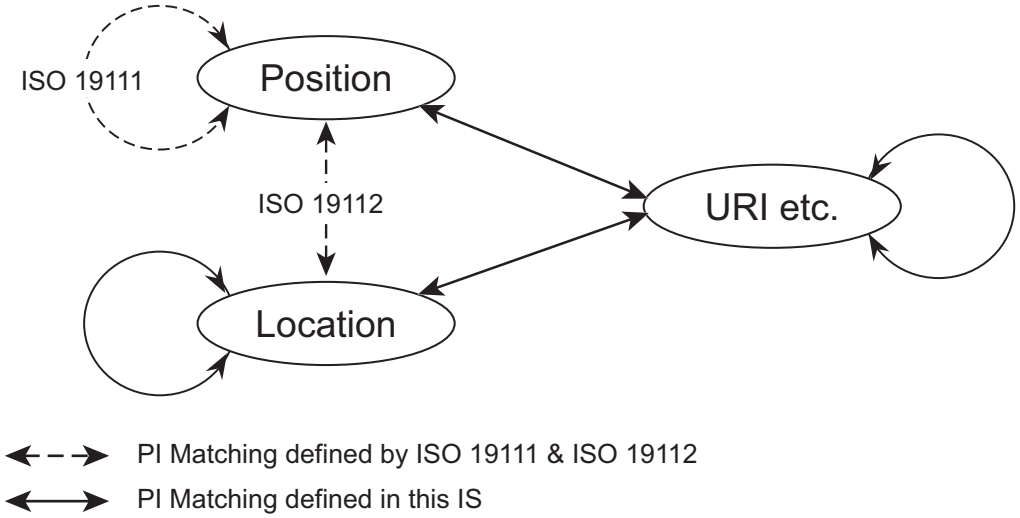

Figure 2 — Place Identifier Matching

6.2 PI Reference Model components

In this International Standard the PI Reference Model defines the basic structure of the PI architecture. An image of the PI Reference Model is shown in Figure 3.

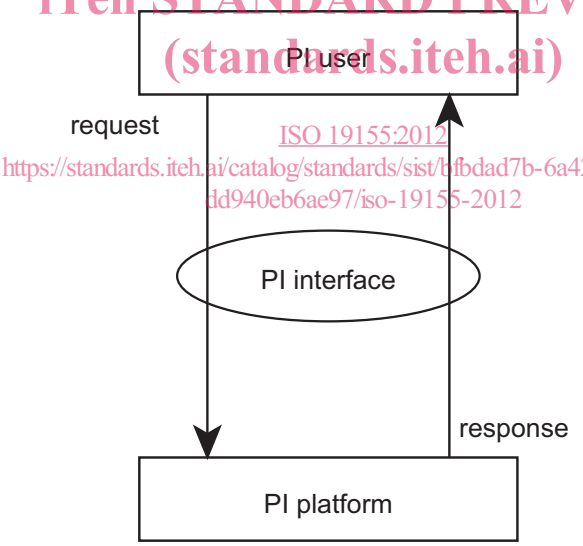

Figure 3 — PI Reference Model

The PI Reference Model consists of three components:

— the PI platform;

— the PI interface;

— a PI user.

The PI platform consists of data and services that are used for PI matching. The PI interface is a standardized interface for requests and responses between the PI platform and a PI user. A PI user is a client that sends requests to, and receives responses from the PI platform through the PI interface.

The PI Reference Model defined in this International Standard is a conceptual model and does not specify an implementation of those components. This model represents a logical structure, not a physical one.

All UML class names in this International Standard shall begin with "PI_" in order to distinguish them from other geographic information standard class names.

6.3 PI platform

The PI platform consists of data and services to register and manage Place Identifiers. The PI platform also specifies a mechanism to match multiple Place Identifiers that identify the same place.

PI_Data is the root class for data in the PI platform. Within PI_Data there are three subclasses: PI_PlaceIdentifier, PI_ReferenceSystem and PI_MatchingTable as shown in Figure 4. PI_PlaceIdentifier specifies the structure of the PI. PI_ReferenceSystem specifies the reference system of the PI. PI_MatchingTable consists of matched sets of multiple Place Identifiers. Each PI in the set identifies the same place.

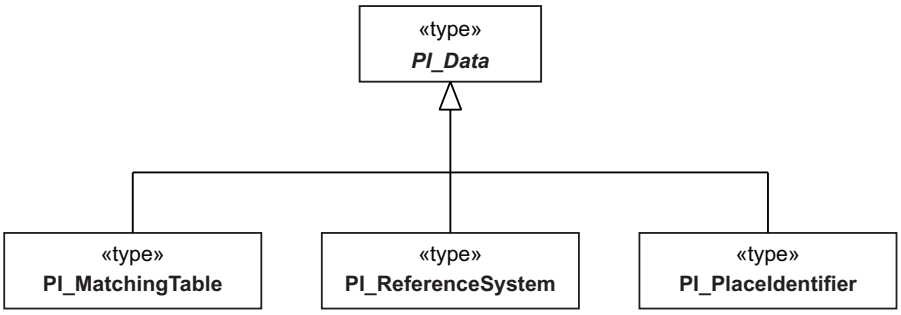

Figure 4 — PI_Data

Details of the PI_Data subclasses are specified in 7.2.2 to 7.2.5.

PI_Service is the root class of services in the PI platform. There are two subclasses: PI_MatchingService and PI_RSService.

The PI_MatchingService manages information for PI matching, and retrieves or transfers the desired PI instances as requested by a user. The PI_RSService manages reference system data obtained from the reference systems which is necessary to facilitate the matching of Place Identifiers. The structure of these services is shown in Figure 5.

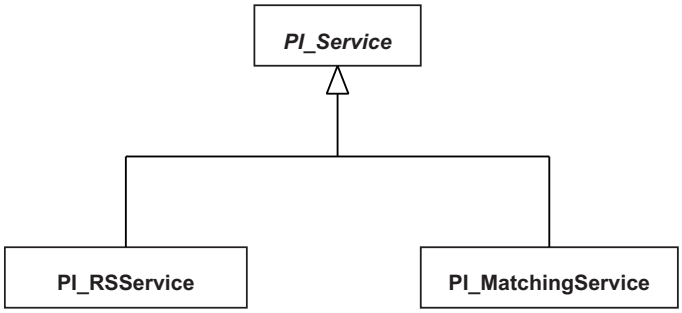

Figure 5 — PI_Service

Figure 5 shows the logical structure of PI services, not a physical structure.

6.4 PI interface

Interfaces are required for using the PI services and retrieving PI data. Within the PI Reference Model, five interfaces are defined:

a) PI update interface;

b) PI retrieval interface;