INTERNATIONAL STANDARD

ISO 19112

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Geographic information — Spatial referencing by geographic identifiers

Information géographique — Système de références spatiales par identificateurs géographiques

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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 19112 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

Geographic information contains geospatial references that relate the features and information represented in the data or text to positions in geographic space. Spatial references fall into two categories:

a) those using coordinates;

b) those using geographic identifiers.

This International Standard deals only with spatial referencing by geographic identifiers. This type of spatial reference is sometimes called “indirect”. Spatial referencing by coordinates is the subject of ISO 19111.

Spatial reference systems using geographic identifiers are not based explicitly on coordinates but on a relationship with a location defined by a geographic feature or features. The relationship of the position to the feature may be as follows:

a) containment, where the position is within the geographic feature, for example in a country;

b) based on local measurements, where the position is defined relative to a fixed point or points in the geographic feature or features, for example at a given distance along a street from a junction with another street;

c) loosely related, where the position has a fuzzy relationship with the geographic feature or features, for example adjacent to a building or between two buildings.

The purpose of this International Standard is to specify ways to define and describe systems of spatial references using geographic identifiers. However, it only covers the definition and recording of the referencing feature, and does not consider the forms of the relationship of the position relative to that feature.

Geographic information — Spatial referencing by geographic identifiers

1 Scope

This International Standard defines the conceptual schema for spatial references based on geographic identifiers. It establishes a general model for spatial referencing using geographic identifiers, defines the components of a spatial reference system and defines the essential components of a gazetteer.

Spatial referencing by coordinates is addressed in ISO 19111. However, a mechanism for recording complementary coordinate references is included.

This International Standard enables producers of data to define spatial reference systems using geographic identifiers and assists users in understanding the spatial references used in datasets. It enables gazetteers to be constructed in a consistent manner and supports the development of other standards in the field of geographic information.

This International Standard is applicable to digital geographic data, and its principles may be extended to other forms of geographic data such as maps, charts and textual documents.

2 Conformance

Two classes of conformance are defined for this International Standard:

— any spatial reference system for which conformance with this document is claimed shall pass all the requirements described in the abstract test suite given in Clause A.1.

— any gazetteer for which conformance with this document is claimed shall pass all the requirements described in the abstract test suite given in Clause A.2.

The definition of an abstract test suite is given in ISO 19105.

3 Normative references

The following referenced documents are indispensable for the application 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 19105:2000, *Geographic information — Conformance and testing*

ISO 19107:2003, *Geographic information — Spatial schema*

ISO 19111:2003, *Geographic information — Spatial referencing by coordinates*

ISO 19115:2003, *Geographic information — Metadata*

4 Terms and definitions

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

4.1
feature
abstraction of real world phenomena

NOTE A feature may occur as a type or an instance. Feature type or instance shall be used when only one is meant.

[ISO 19101: 2002]

4.2
gazetteer
directory of instances of a class or classes of features containing some information regarding position

NOTE The positional information need not be coordinates, but could be descriptive.

4.3
geographic identifier
spatial reference in the form of a label or code that identifies a location

EXAMPLE “Spain” is an example of a country name; “SW1P 3AD” is an example of a postcode.

4.4
location
identifiable geographic place

EXAMPLE “Eiffel Tower”, “Madrid”, “California”

4.5
spatial reference
description of position in the real world

NOTE This may take the form of a label, code or set of coordinates.

4.6
spatial reference system
system for identifying position in the real world

5 Notation

5.1 Unified Modelling Language (UML)

The diagrams that appear in this document are presented using the Unified Modelling Language (UML) static structure diagram with the ISO Interface Definition Language (IDL) basic type definitions and the UML Object Constraint Language (OCL) as the conceptual schema language. The UML notations used in this standard are described in Figure 1.

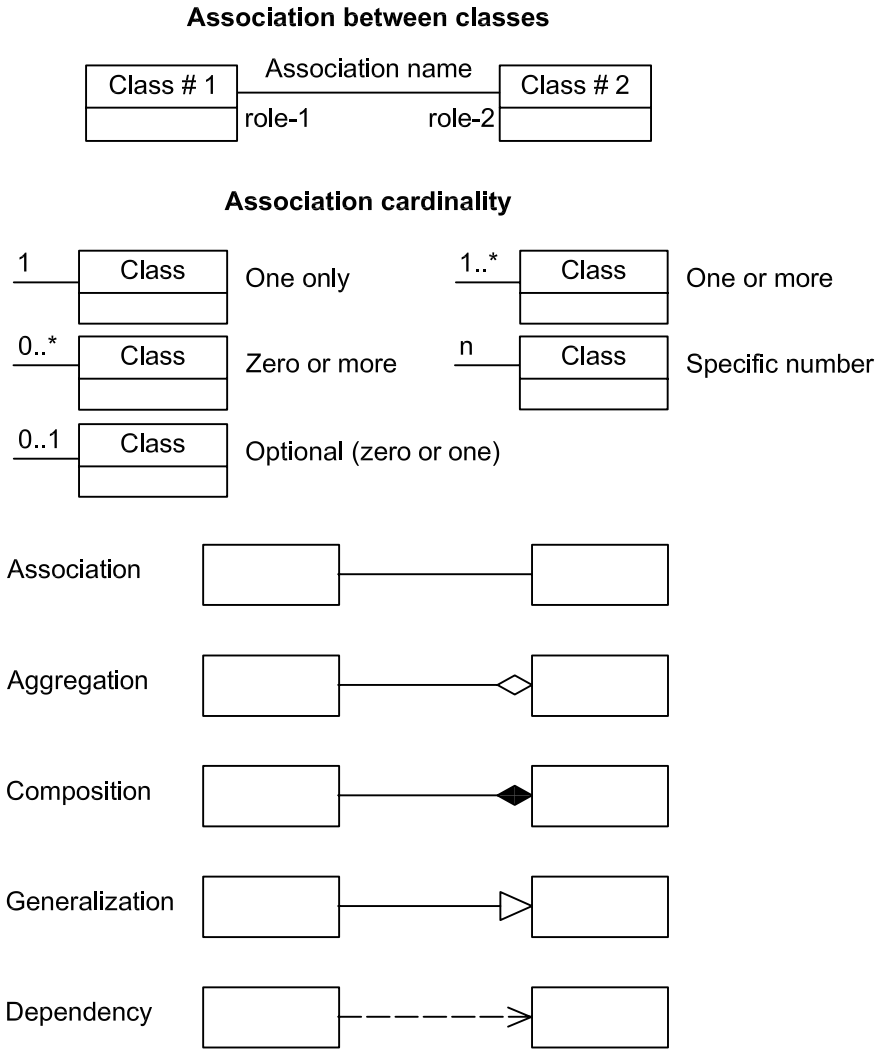

Figure 1 — UML notation

This International Standard defines the following UML packages:

— SI_Gazetteer;

— SI_LocationInstance;

— SI_LocationType.

Reference is made to the following UML packages defined in other International Standards:

— EX_GeographicExtent, defined in the Extent package in ISO 19115:2003;

— EX_TemporalExtent, defined in the Extent package in ISO 19115:2003;

— CI_ResponsibleParty, defined in Citation in ISO 19115:2003;

— GM_Point, defined in the Geometry package in ISO 19107:2003;

— SC_CRS, defined in ISO 19111:2003.

5.2 Attribute tables

The tables of attributes that appear in this International Standard show the following elements:

— element name: a label assigned to the element;

— description: the element description;

— obligation: whether the element shall always be recorded (M), or is optional (O), or is conditional on the stated condition being met (C);

— maximum occurrence: the number of instances that the element may have, one (1) or many (N);

— data type: a set of distinct values representing the element;

— domain: the values allowed or the use of free text.

6 Concepts of spatial referencing using geographic identifiers

6.1 Spatial referencing using geographic identifiers

The position of a feature is identified by a spatial reference. Where a geographic identifier is used as this spatial reference, it uniquely identifies a location. This location is a feature used to reference other features.

NOTE The spatial reference of a feature in a geographic dataset is usually held as an attribute of the feature, and defines an association with a location. The relationship with the location is usually that of containment within. However, more complex spatial references may be constructed using relationships such as “adjacent to” and “distance along” together with a measured distance and direction from the location identified. Reference systems for roads and railways are often based on a measured distance from one node (end point or intersection) along a link (road or track). The spatial reference system used in a dataset forms part of the metadata for that dataset, as defined in ISO 19115.

These concepts are illustrated in Figure 2, which applies at both the type and instance level.

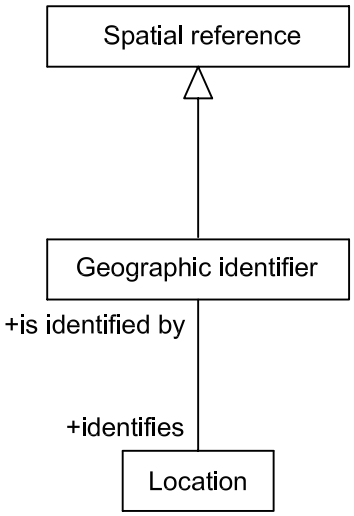

Figure 2 — The concepts of spatial referencing using geographic identifiers

6.2 Spatial reference systems using geographic identifiers

A spatial reference system using geographic identifiers comprises a related set of one or more location types, together with their corresponding geographic identifiers. These location types may be related to each other through aggregation or disaggregation, possibly forming a hierarchy.

Examples of spatial reference systems using geographic identifiers are shown in Table 1.

Table 1 — Examples of spatial reference systems

Spatial reference system	Location type	Geographic identifiers
countries as defined in ISO 3166-1	country	country name country code
set of population centres in a region	town	town name
addresses in a town	property	property address
hydrological hierarchy	river basin river river reach	river basin name river name river reach reference
link – node	link	link code

6.3 Gazetteers

A gazetteer is a directory of geographic identifiers describing location instances. It will contain additional information regarding the position of each location instance. It may include a coordinate reference, but it may also be purely descriptive. If it contains a coordinate reference, this will enable transformation from the spatial reference system using geographic identifiers to the coordinate reference system. If it contains a descriptive reference, this will be a spatial reference using a different spatial reference system with geographic identifiers, for example the postcode of a property. For any location type, there may be more than one gazetteer.

The relationships among spatial reference system, location and gazetteer are shown in Figure 3.

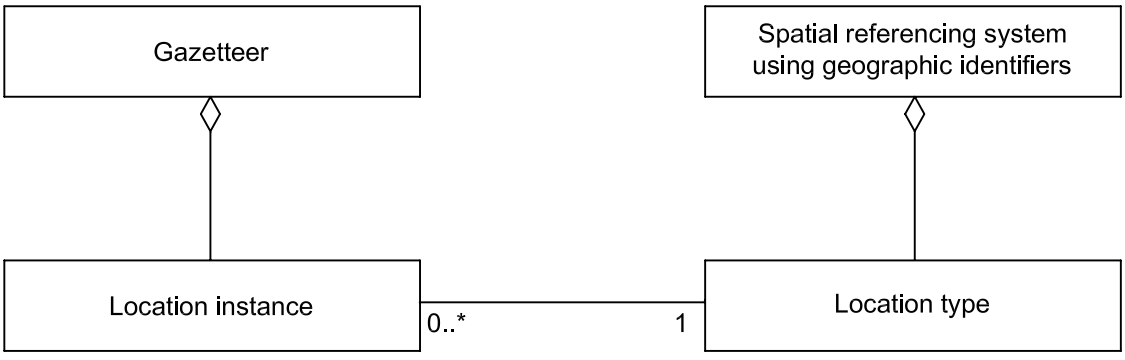

Figure 3 — Spatial reference system using geographic identifiers

7 Requirements for spatial reference systems using geographic identifiers

7.1 Attributes of a spatial reference system using geographic identifiers

A spatial reference system using geographic identifiers shall comprise one or more location types (which may be related). Each location instance shall be uniquely identified by means of a geographic identifier.

A spatial reference system using geographic identifiers shall be minimally described by the following attributes:

— name;

— theme;

— overall owner;

— territory of use.

Details of these elements are shown in Table 2. A UML schema is given in Figure 4, and an example description of a spatial reference system is given in Annex B.

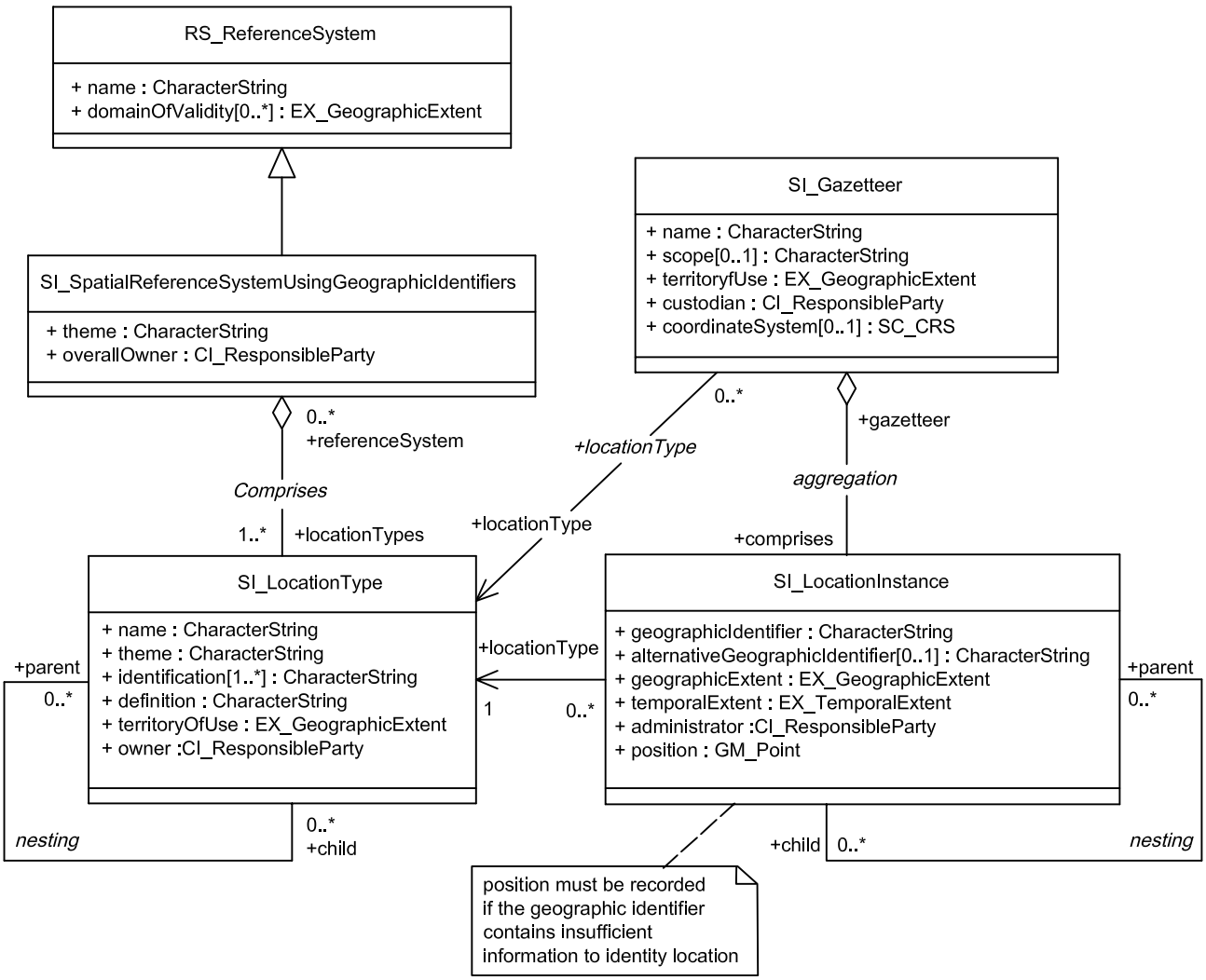

Figure 4 — UML model of spatial referencing using geographic identifiers

A new version of the spatial reference system shall be created whenever any location type is created or destroyed, or a new version of a location type is created. The version reference is included in the name of the spatial reference system.

Table 2 — Elements of a spatial reference system using geographic identifiers

Element name	UML identifier	Description	Obligation [M (mandatory); see 5.2]	Maximum occurrence [1 (one) or N (many)]	Data Type (UML class)	Domain (allowable values)
name	name	identifier of the spatial reference system	M	1	CharacterString	free text
domain of validity	domainOfValidity	geographic area within which the reference system occurs	M	1	EX_GeographicExtent	see ISO 19115
theme	theme	property used to characterize the spatial reference system	M	1	CharacterString	free text
overall owner	overallOwner	authority with overall responsibility for the spatial reference system	M	1	CI_ResponsibleParty	see ISO 19115
location type	locationType	name of location type in the spatial reference system	M	N	association	SI_LocationType

7.2 Attributes of a location type

For each location type in the spatial reference system, the following attributes shall be identified:

— name;

— theme;

— identification;

— definition;

— territory of use;

— owner.

In addition, the following associations may also exist:

— parent location type;

— child location type.

Details of these elements are shown in Table 3. An example is given in Annex B.

A new version of the location type shall be created whenever any change occurs to any of its attributes.

Table 3 — Elements of a location type in a spatial reference system

Element name	UML identifier	Description	Obligation [M (mandatory), O (optional); see 5.2]	Maximum occurrence [1 (one) or N (many)]	Data Type (UML class)	Domain (allowable values)
name	name	name of the location type	M	1	CharacterString	free text
theme	theme	property used as the defining characteristic of the location type[a]	M	1	CharacterString	free text
identification	identification	method of uniquely identifying location instances[b]	M	N	CharacterString	free text
definition	definition	the way in which location instances are defined[c]	M	1	CharacterString	free text
territory of use	territoryOfUse	geographic area within which the location type occurs[d]	M	1	EX_GeographicExtent	see ISO 19115
owner	owner	name of organization or class of organization able to create and destroy location instances	M	1	CI_ResponsibleParty	see ISO 19115
parent location type	parent	name of parent location type (a location type of which this location type is a sub-division)[e]	O	N	association	SI_LocationType
child location type	child	name of child location type (a location type which sub-divides this location type) [e]	O	N	association	SI_LocationType

[a] Examples of theme are “administration”, “electoral”, and “postal”.

[b] Examples of labelling method are “name” and “code”.

[c] The definition of the location type shall be in the form of one of the following:

- an area, defined by a set of boundaries, for example countries defined by their borders;
- a single feature, for example a street defined by its centre line, or a junction of two such streets;
- a collection of smaller features, for example trade areas defined by groups of countries.

Where a location type is defined as a collection of smaller units, an instance of that location need not have a well-defined boundary, for example a postal code defined as a collection of postal delivery points.

[d] An example of the geographic domain for a location type “rivers” might be “North America”.

[e] Parent and child location types are linked to the location type by the nesting association.

8 Requirements for gazetteers

8.1 Properties of a gazetteer

A gazetteer is a directory of instances of location types in a spatial reference system.

NOTE 1 There may be several different gazetteers for the same location type, with the location instances identified in different ways. Conversely, a single gazetteer may include variant identifications of single location instances.

A gazetteer shall have the following minimum set of attributes:

— name;

— territory of use;

— custodian.

The following may also be recorded:

— scope;

— coordinate reference system.

NOTE 2 The coordinate reference system provides a linking mechanism between referencing using geographic identifiers and referencing using coordinates.

Details of these elements are shown in Table 4. Examples of gazetteer data are given in Annex C.

A new version of the gazetteer shall be created whenever any location instance is created or destroyed, or a new version of a location instance is created.

Table 4 — Elements of a gazetteer

Element name	UML identifier	Description	Obligation [M (mandatory), O (optional); see 5.2]	Maximum occurrence [1 (one) or N (many)]	Data Type (UML class)	Domain (allowable values)
identifier	identifier	name of the gazetteer[a]	M	1	CharacterString	free text
scope	scope	description of the location types contained in the gazetteer[b]	O	1	CharacterString	free text
territory of use	territoryOfUse	geographic domain covered by the gazetteer[c]	M	1	EX_GeographicExtent	see ISO 19115
custodian	custodian	name of the organization responsible for maintenance of the gazetteer	M	1	CI_ResponsibleParty	see ISO 19115
coordinate reference system	coordinateSystem	name of coordinate reference system used in the gazetteer for describing position	O	1	SC_CRS	see ISO 19111
location type	SI_LocationType	name of location type for which instances are recorded in the gazetteer	M	N	association	SI_Location Type

[a] Version date of the gazetteer is included in name.

[b] Examples of scope are “streets of London” and “rivers of North America”.

[c] Examples of geographic domain are for a gazetteer of rivers, “North America”, and for a gazetteer of streets, “London”

8.2 Attributes of location instance

The minimum set of attributes of each location instance shall be as follows:

— geographic identifier;

— geographic extent;

— administrator.

The following may also be recorded:

— temporal extent;

— alternative geographic identifier;

— position;

— parent location instance;

— child location instance.

Details of these attributes are shown in Table 5. Examples of gazetteer data are given in Annex C.

A new version of a location instance shall be created whenever any change occurs to any of its attributes, for example when a local authority administrative area has incurred a change in its boundary.

Table 5 — Data to be recorded in a gazetteer of location instances

Element name	UML identifier	Description	Obligation [M (mandatory, O (optional), C (conditional); see 5.2]	Maximum occurrence [1 (one) or N (many)]	Data Type (UML class)	Domain (allowable values)
geographic identifier	Geographic Identifier	unique identifier for the location instance[a]	M	1	CharacterString	free text, number or code
temporal extent	temporalExtent	date of creation of this version of the location instance[b]	O	1	EX_TemporalExtent	see ISO 19115
alternative geographic identifier	Alternative Geographic Identifier	other identifier for the location instance	O	N	CharacterString	free text, number or code
geographic extent	geographicExtent	description of the location instance[c]	M	1	EX_GeographicExtent	see ISO 19115
position	position	coordinates of a representative point for the location instance[d]	C/ geographic identifier contains insufficient information to identify location	1	GM_Point	See ISO 19107
administrator	administrator	name of organization responsible for defining the characteristics of the location instance	M	1	CI_ResponsibleParty	see ISO 19115
parent location instance	parent	name of a location instance of a different location type, for which this location instance is a sub-division	O	N	association	SI_Location Instance

Table 5 (*continued*)

Element name	UML identifier	Description	Obligation [M (mandatory, O (optional), C (conditional); see 5.2]	Maximum occurrence [1 (one) or N (many)]	Data Type (UML class)	Domain (allowable values)
child location instance	child	name of a location instance of a different location type which subdivides this location instance	O	N	association	SI_Location Instance

[a] In order to ensure that a geographic identifier is unique within a wider geographic domain, the geographic identifier may need to include an identifier of an instance of a parent location type, for example “Paris, Texas”.

[b] The temporal extent will normally be the date of creation of this version.

[c] The geographic extent shall be defined in one of the following ways:

- as a collection of smaller geographic features, for example the European Union, defined by its constituent countries;
- by a bounding polygon, described by either of the following:
  - as a closed set of boundary segments (each defined by one or more geographic features), for example a block defined by the bounding streets;
  - by a set of coordinates, for example, a land parcel defined by the coordinates of its boundary.

[d] An example of the position is the coordinates of the centroid of the location instance. This provides a linking mechanism to spatial referencing by coordinates.

Annex A
(normative)

Abstract test suites

A.1 Conformance of a spatial reference system using geographic identifiers

A.1.1 Abstract test suite

To check that a spatial referencing system using geographic identifiers is in conformance with this document, verify that it satisfies the requirements given in A.1.2 and A.1.3.

A.1.2 Construction

a) Test purpose: Check the construction of the spatial reference system.

b) Test method: Check that the spatial reference system is well-defined and comprises a set of location types with a common theme.

c) Reference: 7.1

d) Test type: Basic

A.1.3 Location types

e) Test purpose: Check that each location type is well-defined and uniquely identified by means of one or more geographic identifier type(s).

f) Test method: Check that the attributes of each location type are known, and that there is a gazetteer of location instances.

a) Reference: 7.2 and 8.1

b) Test type: Basic

A.2 Conformance of a gazetteer

A.2.1 Abstract test suite

To check that a gazetteer is in conformance with this document, verify that it satisfies the requirements given in A.2.2 and A.2.3.

A.2.2 Construction

a) Test purpose: Check the structure of the gazetteer.

b) Test method: Check that the properties of the gazetteer are known.

c) Reference: 8.1

d) Test type: Basic

A.2.3 Attribute data

e) Test purpose: Check that all attributes of each location type recorded in the gazetteer are correctly defined.

f) Test method: Check that all instances of the location are recorded in the gazetteer and that the attribute data for each are correctly recorded.

a) Reference: 8.2

b) Test type: Basic

Annex B
(informative)

Example spatial reference system using geographic identifiers

An example of a spatial reference system using geographic identifiers is the addressing of properties in the UK. This can be described as follows.

name	UK property addressing
domain of validity	UK
theme	property
overall owner	Office for National Statistics
location types	administrative area, town, locality, street, property

A description of the location types is given in Table B.1.

Table B..1 — Example description of location types

name	theme	identifier	definition	territory of use	owner	parent	child
administrative area	local administration	name	area of responsibility of highest level local authority	UK	UK government	none	town
town	built environment	name	city or town	UK	Ordnance Survey	administrative area	locality
locality	community	name	neighbourhood, suburb, district, village, or settlement	UK	local authority	town	street
street	access	unique street reference number	thoroughfare providing access to properties	UK	Highway Authority	locality, town or administrative area	basic land and property unit
property	built environment	geographic address	land use	UK	local authority	street	none

Annex C
(informative)

Examples of gazetteer data

C.1 Administrative areas

A gazetteer of administrative areas can be described as follows.

identifier	administrative area
scope	local authority areas
territory of use	UK
custodian	Office for National Statistics
coordinate reference system	National Grid of Great Britain
location types	County Councils and Unitary Authorities

The following is a valid record.

geographic identifier	Cambridgeshire
temporal extent	19960401
alternative geographic identifier	CC
geographic extent	5300 2370, 5630 2470, 5460 3190, 5020 3060
position	5448 2583
administrator	Office for National Statistics
parent location instance	England

C.2 Towns

A gazetteer of towns can be a described as follows.

identifier	Towns
scope	large population centres
territory of use	UK
custodian	Ordnance Survey
coordinate reference system	National Grid of Great Britain
location type	town

The following is a valid record.

geographic identifier	Cambridge
temporal extent	19960401
alternative geographic identifier	none
geographic extent	5414 2596, 5440 2532, 5493 2545, 5487 2598, 5455 2618
position	5448 2583
administrator	Cambridgeshire County Council
parent location instance	Cambridgeshire

C.3 Localities

A gazetteer of localities can be a described as follows.

identifier	Localities
scope	local communities
territory of use	Cambridge
custodian	Cambridge City Council
coordinate reference system	National Grid of Great Britain
location type	locality

The following is a valid record.

geographic identifier	Chesterton
temporal extent	19970401
alternative geographic identifier	none
geographic extent	5466 2613, 5448 2594, 5464 2592, 5474 2604
position	5453 2595
administrator	Cambridge City Council
parent location instance	Cambridge

C.4 Streets

A gazetteer of streets can be described as follows.

identifier	National Street Gazetteer
scope	UK streets
territory of use	UK
custodian	Ordnance Survey
coordinate reference system	National Grid of Great Britain
location type	street

The following is a valid record.

geographic identifier	Church Street
temporal extent	19980401
alternative geographic identifier	54672
geographic extent	5461 2598, 5463 2598
position	5463 2597
administrator	Cambridgeshire County Council
parent location instance	Chesterton

C.5 Properties

A gazetteer of properties can be a described as follows.

identifier	National Land and Property Gazetteer
scope	UK property
territory of use	UK
custodian	Ordnance Survey
coordinate reference system	National Grid of Great Britain
location type	property

The following is a valid record.

geographic identifier	1
temporal extent	19990401
alternative geographic identifier	CB4 1DT 1
geographic extent	54626 25973, 54629 25970, 54631 25974, 54627 25976
position	54629 25973
administrator	Cambridge City Council
parent location instance	Church Street

Bibliography

[1] ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

[2] ISO 19101:2002, *Geographic information — Reference model*

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