S-100 – Part 2b

Data Dictionary Register

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2b-1 Scope

The IHO Geospatial Information (GI) Registry contains a number of Registers, one of which is the Data Dictionary Register (DDR). The Data Dictionary Register expands on the concepts stored in the Concept Register (see S-100 Part 2a), by including the assignment of item types and feature binding in discrete Domains within the Register. This allows S-100 based Product Specification developers to develop their data models to best suit their specific requirements for representation of the real world.

This Part describes the content of the Register and specifies procedures to be followed in establishing, maintaining, and publishing dictionaries of unique, unambiguous and permanent identifiers that are assigned to items of geographic, hydrographic and metadata information. In order to accomplish this purpose, this Part specifies elements of information that are necessary to provide identification and definitions to the registered items.

2b-1.1 Conformance

This profile conforms to conformance class 2 of ISO 19106:2004. The following is a brief description of the specializations and generalizations where the profile differs from ISO 19126:2008.

1) A new class, S100_CD_InformationConcept is introduced.
2) New classes, S100_CD_FeatureBinding, S100_CD_InformationBinding and S100_FC_AttributeBinding are introduced.
3) A new class, S100_CD_AttributeConstraints is introduced.
4) The class FC_FeatureAttribute is specialized to be the abstract class S100_CD_Attribute.
5) New classes, S100_CD_SimpleAttributeConcept and S100_CD_ComplexAttributeConcept are introduced.
6) A new class, S100_CD_InformationRole is introduced.
7) The classes CD_InheritanceRelation, CD_FeatureOperation CD_Binding, CD_Constraint and CD_BoundFeatureAttribute are not used.

2b-2 Normative references

The following referenced documents are required 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 amendments) applies.

ISO 19135:2005, *Geographic Information – Procedures for registration of items of geographic information*

ISO 19126:2009, *Geographic Information – Feature concept dictionaries and registers*

ISO 8601:2004, *Data elements and interchange formats - Information interchange - Representation of dates and times*

ISO/IEC 10646:2017, *Information Technology – Universal Coded Character Set (UCS)*

RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax*. T. Berners-Lee, R. Fielding, L. Masinter. Internet Standard 66, IETF. URL: http://www.ietf.org/rfc/rfc3986.txt or http://www.rfc-editor.org/info/std66

RFC 2141, *URN Syntax*. R. Moats. IETF RFC 2141, May 1997. URL: https://www.ietf.org/rfc/rfc2141.txt

W3C *XML Schema Part 2: Datatypes* Second Edition, Appendix F *Regular Expressions*. URL: https://www.w3.org/TR/xmlschema-2/#regexs

2b-3 General concepts

2b-3.1 Register

As described in Part 2, a Register is simply a managed list. It is easier to maintain than a fixed document, because new items can be added as needed to the Register, and existing items in the Register can be clarified, superseded or retired. Each Register item has one or more dates associated with it that indicate when changes in its status occurred. This means that a Product Specification, defined at a given date, may reference an item in the Register at that specific point in time.

2b-3.2 Data Dictionary Register

The Data Dictionary Register specifies independent sets of definitions of features, attributes, enumerated values, and information types that may be used to describe geographic, hydrographic, and metadata information. The Data Dictionary Register may be used to assign an item defined in the Concept Register a type (for example feature, attribute and enumerate value); and define recommended associations and attribute/feature bindings to facilitate the development of Feature Catalogues. Items in the Concept Register can only be registered once against each type in the Data Dictionary Register in order to support interoperability.

Such Data Dictionaries of geospatial information may serve as sources of reference for similar Data Dictionaries or Registers established by other geographic information communities as part of a system of cross-referencing.

2b-3.3 Feature Catalogue

A Feature Catalogue is a document that describes the content of a data product. It uses item types, for example features and attributes, from one or more Data Dictionaries and binds them together. In addition constraints, units of measurement and format description of attributes can be specified. Feature Catalogues are described in detail in S-100 Part 5.

2b-4 IHO Data Dictionary Register

2b-4.1 Types of registered items

The following are types of items, as derived from the Concept Register, which may be registered within the Data Dictionary Register:

1) Feature – abstraction of real world phenomena.
2) Attribute – characteristic of a feature concept.
3) Enumerated Value – one of a set of mutually exclusive values constituting the domain of an attribute.
4) Information – an identifiable object that contains attributes, associations to other information concepts, but no spatial information.
5) Codelist – an open enumeration, or the identifier of a vocabulary (mapping between codes, labels and definitions).

2b-4.2 Data model of the IHO Data Dictionary Register

2b-4.2.1 UML Model

The following Figure shows the information model of the IHO Data Dictionary Register:

Figure 2b-1 – IHO Data Dictionary Register

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2b-4.2.2 S100_RE_Register

The class S100_RE_Register models a Register in a Registry. Further details can be found in S-100 Part 2, clause 2-8.2.

2b-4.2.3 S100_RE_RegisterItem

The class S100_RE_RegisterItem carries the characteristics that are common to all types of registered items. Further details can be found in S-100 Part 2, clause 2-8.3.

2b-4.2.4 RE_ItemStatus

The enumeration RE_ItemStatus identifies the registration status of the S100_RE_RegisterItem. Further details can be found in S-100 Part 2, clause 2-8.4.

2b-4.2.5 S100_CD_Feature

This class is derived from S100_RE_RegisterItem. It defines the following additional properties:

Role Name	Name	Description	Mult	Data Type	Remarks
Class	S100_CD_Feature	A feature type in a Data Dictionary	-	-	Derived from S100_Concept
Attribute	featureUseType	The intended use of a feature type	1	S100_CD_FeatureUseType	
Attribute	alphaCodeIdentifier	Abbreviation designating the feature type	0..1	S100_CD_AlphaCode	See below
Association role	distinction	References to feature types that this feature type is distinct from	0..*	S100_CD_Feature	
Association	conceptReference	References S100_Concept as the base class	1	S100_Concept	

2b-4.2.6 S100_CD_FeatureUseType

Role Name	Name	Description	Remarks
Enumeration	S100_CD_FeatureUseType	Categories of feature types	
Literal	geographic	carries the descriptive characteristics of a real world entity	
Literal	meta	Delineates geographic location where meta information is applicable" distinct from an Information Type which carries information related to features which are related	

Literal	cartographic	carries information about the cartographic representation (including text) of a real world entity	
Literal	theme	Grouping features thematically	

2b-4.2.7 S100_CD_Attribute

Attributes may either be simple or complex. A simple attribute carries a specific value such as a date. A complex attribute is an aggregation of other attributes either simple or complex. Examples of complex attributes are in Appendix 2b-A. This class is derived from S100_RE_RegisterItem and describes the common characteristics of all attribute types.

Role Name	Name	Description	Mult	Data Type	Remarks
Class	S100_CD_Attribute	Base class of all attribute types in a Data Dictionary	-	-	Derived from S100_Concept
Attribute	alphaCodeIdentifier	Abbreviation designating the attribute type	0..1	S100_CD_AlphaCode	See below
Association	conceptReference	References S100_Concept as the base class	1	S100_Concept	

2b-4.2.8 S100_CD_SimpleAttribute

Role Name	Name	Description	Mult.	Data Type	Remarks
Class	S100_CD_SimpleAttribute	A simple attribute type in a Data Dictionary	-	-	Derived from S100_CD_Attribute
Attribute	valueType	Describes representation, interpretation and structure of values	1	S100_CD_AttributeValueType	See below
Attribute	quantitySpecification	Specification of the quantity, for example length, volume, depth, weight etc	0..1	S100_CD_QuantitySpecification	
Association	constraints	Constraints of the attribute type	0..1	S100_CD_AttributeConstraints	Must be consistent with dataType

If the *valueType* is S100_Codelist exactly one of the following must be true:

1) There is an associated S100_RE_Reference with the namespace of a dictionary that is listed in the GI Register.
2) There is at least one S100_CD_EnumeratedValue associated to the attribute.

Condition 1 identifies the dictionary for codelists of type “open dictionary” or “closed dictionary”. Condition 2 provides the enumerated value(s) for codelists of type “open enumeration”. The precise codelist type is determined in individual Product Specifications.

2b-4.2.9 S100_CD_QuantitySpecification

Role Name	Name	Description	Remarks
Enumeration	S100_CD_QuantitySpecification	Types of quantity measures	Adapted from ISO 19103 Measure Types
Literal	angularVelocity	The instantaneous rate of change of angular displacement with time	From ISO 19103
Literal	area	The measure of the physical extent of any two-dimensional geometric object	From ISO 19103
Literal	density	Mass per unit volume; number per unit area. Also: specific gravity (S-32). Density of soundings is the intervals between lines of sounding and soundings in the same line (S-32)	“Density” can be used in different senses, the unit of measure and attribute definition must make it clear which is intended
Literal	duration	Interval of time	
Literal	frequency	Number of vibrations or cycles per unit time	IHO S-32
Literal	length	The longest dimension of an object; distance measured along a line or curve	
Literal	mass	A numerical measure of the inertia of an object; the quantity of matter which a body contains, irrespective of its bulk or volume	
Literal	planeAngle	The amount of rotation needed to bring one line or plane into coincidence with another, generally measured in radians or degrees	From ISO 19103 “angle”
Literal	power	Rate of doing work or transferring energy; magnification	S-32 refers “power” to “magnifying power: the ratio of the apparent length of a linear dimension as seen through an optical instrument to that seen by the unaided eye”. The unit of measure and attribute definition must make it clear which sense is intended
Literal	pressure	Force per unit area	
Literal	salinity	A measure of the quantity of dissolved salts	IHO S-32 (abbrev.)
Literal	speed	Rte of change of position with time	Usually calculated using the simple formula, the change in position during a given time interval. Speed is a scalar physical quantity, having magnitude but not direction. Contrast to “velocity” which is a vector

Role Name	Name	Description	Remarks
			quantity having both magnitude and direction. (Adapted from ISO 19103 “velocity”)
Literal	temperature	The intensity or degree of heat	IHO S-32
Literal	volume	The measure of the physical space of any 3-D geometric object	From ISO 19103
Literal	weight	The force experienced by an object due to gravity	
Literal	otherQuantity	A quantity different from the other literals of this enumeration	

2b-4.2.10 S100_CD_AttributeValueType

Role Name	Name	Description	Remarks
Enumeration	S100_CD_AttributeValueType	Value types of simple attributes	
Literal	boolean	True or False	
Literal	enumeration	List of predetermined values that can be expanded and contracted	
Literal	integer	Numeric value with defined range, units and format	
Literal	real	Floating point number	
Literal	text	A sequence of characters	
Literal	date	Character encoding shall follow the format for date as specified by ISO 8601	
Literal	time	Character encoding shall follow the format for time as specified by ISO 8601	
Literal	dateTime	Character encoding shall follow the format for date and time as specified by ISO 8601	
Literal	URI	Character encoding shall follow the format for URI as specified by RFC 3986	
Literal	URL	Character encoding shall follow the format for URL as specified by RFC 3986	

Literal	URN	Character encoding shall follow the format for URN as defined by RFC 2141	
Literal	S100_CodeList	Open enumeration or identifier of entry in a vocabulary	
Literal	S100_TruncatedDate	Truncated format for date	

2b-4.2.11 S100_CD_AttributeConstraints

Role Name	Name	Description	Mult.	Data Type	Remarks
Class	S100_CD_AttributeConstraints	Constraints of a simple attribute	-	-	
Attribute	stringLength	Shall be represented as a positive integer (that is, greater than zero) that specifies the maximum number of characters that may be assigned to the text attribute type. If not specified, then the text length shall be unconstrained	0..1	PositiveInteger	
Attribute	textPattern	A character string that specifies a scheme of one or more constraints on the structure of the text values that may be assigned to the attribute. This shall be achieved by using a regular expression. W3C XML Schema Part 2: Datasets Second Edition, Appendix F (Regular Expressions) shall be used to define text patterns in this standard	0..1	CharacterString	
Attribute	range	Specifies the range of allowed numeric values	0..1	S100_NumericRange	
Attribute	precision	Specifies the precision of a real number	0..1	NonNegativeInteger	

2b-4.2.12 S100_CD_ComplexAttribute

Role Name	Name	Description	Mult	Data Type	Remarks
Class	S100_CD_ComplexAttribute	A complex attribute type in a Data Dictionary	-	-	Derived from S100_CD_Attribute
Association	subAttribute	References the sub attribute	1..*	S100_CD_AttributeConcept	Characteristics defined by S100_CD_AttributeUsage

2b-4.2.13 S100_CD_AttributeUsage

This class specifies the characteristics of the association between a complex attribute type and its sub attributes.

Role Name	Name	Description	Mult	Data Type	Remarks
Class	S100_CD_AttributeUsage	Characteristics of the association between a complex attribute and its sub attributes	-	-	
Attribute	multiplicity	Number of occurrences of the sub attribute	1	S100_Multiplicity	
Attribute	sequential	Boolean value that indicates if the sub attributes of a complex attribute are in a particular order	1	Boolean	It is only applicable if a sub attribute has multiplicity > 1

2b-4.2.14 S100_CD_EnumeratedValue

This class is derived from S100_RE_RegisterItem and describes the characteristics of an enumerated value type.

Role Name	Name	Description	Mult	Data Type	Remarks
Class	S100_CD_EnumeratedValue	Characteristics of an enumerated value type in a Data Dictionary	-	-	
Attribute	numericCode	A positive integer designating the unique value in the domain	1	PositiveInteger	
Association	associatedAttribute	Specifies the attribute type item for which this is a domain value	1	Boolean	
Association	conceptReference	References S100_Concept as the base class	1	S100_Concept	

2b-4.2.15 S100_CD_Information

Role Name	Name	Description	Mult	Data Type	Remarks
Class	S100_CD_Information	Characteristics of an information type in a Data Dictionary	-	-	

Attribute	alphaCodeIdentifier	Abbreviation designating the information type item	0..1	S100_CD_AlphaCode	See below
Association	distinction	Similar information types that this is distinct from	0..1	S100_CD_Information	
Association	conceptReference	References S100_Concept as the base class	1	S100_Concept	

2b-4.2.16 S100_RE_ReferenceSource

Each item in a Feature Concept Dictionary has a definition. If the definition is taken from an external source, this class describes the reference(s) to the source document. Further details can be found in S-100 Part 2.

2b-4.2.17 S100_RE_Reference

This class defines the references to other documents where additional information regarding a registered item can be found. Further details can be found in S-100 Part 2.

2b-4.2.18 S100_RE_ManagementInfo

This class contains the management information of a register item. Further details can be found in S-100 Part 2.

2b-4.2.19 S100_Concept

The class S100_Concept identifies the required information for the Concept Register. Further details can be found in S-100 Part 2.

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Appendix 2b – A
Example of a complex attribute
(informative)

NOTE: The following example does not reflect the modelling of lights in any S-100 based Product Specification.

A light may have several sectors. All of them share the same light characteristic and sequence. Other common attributes are the height and the name.

All attributes describing one sector in a complex attribute are structured “Light sector”.

A complex attribute for the “Rhythm of light” is also defined.

The simple attributes used in “lightSector” are:

- sectorLimit1 (type Real)
- sectorLimit2 (type Real)
- colour (type Enumeration)
- valueOfNominalRange (type Real)

Therefore the complex attribute is:

Characteristic	Value	
Name	Light sector	
Definition	A sector is the part of a circle between two straight lines drawn from the centre to the circumference. (Advanced Learner’s Dictionary, 2nd Edition).	
Remarks	n/a	
CamelCase	lightSector	
AlphaCode	LITSEC	
Sub Attributes	**Attribute Binding**	
CamelCode Identifier	**multiplicity**	**sequential**
sectorLimit1	1	n/a
sectorLimit2	1	n/a
colour	1	n/a
valueOfNominalRange	0..1	n/a

Note: The multiplicity and sequence are carried in the attribute between the complex and sub-attribute.

The “Rhythm of light” consists of:

- lightCharacteristic
- signalPeriod
- signalGroup

Characteristic	Value
Name	Rhythm of light
Definition	
Remarks	n/a
CamelCase	rhythmOfLight
AlphaCode	RHYLGT

Sub Attributes	Attribute Binding	
CamelCode Identifer	**multiplicity**	**sequential**
lightCharacteristic	1	n/a
signalPeriod	0..1	n/a
signalGroup	0..1	n/a

A second way of describing the rhythm of light is the “signal sequence” as it is done with the S-57 SIGSEQ attribute. A signal sequence consists of intervals where the signal is either on or off (here light or eclipse)

Characteristic	Value	
Name	Signal sequence interval	
Definition	tbd.	
Remarks	n/a	
CamelCase	signalSequenceInterval	
AlphaCode	SGSQIN	
Sub Attributes	**Attribute Binding**	
CamelCode Identifer	**multiplicity**	**sequential**
signalStatus	1	n/a
duration	1	n/a

A Signal sequence is then just an ordered list of those intervals.

Characteristic	Value	
Name	Signal sequence	
Definition	The sequence of times occupied by intervals of light and eclipse for all “light characteristics”. (Adapted from S-57 Edition 3.1, Appendix A – Chapter 2, Page 2.191, November 2000).	
Remarks	n/a	
CamelCase	signalSequence	
AlphaCode	SIGSEQ	
Sub Attribute	**Attribute Binding**	
CamelCode Identifier	**multiplicity**	**sequential**
signalSequenceInterval	1..*	True

A light object would now consist of:

Light:

- rhythmOfLight [1..*]
- lightSector [1..*]
- signalSequence [0..1]
- objectName[0..1]
- height[0..1]

This definition would be included in the Feature Catalogue, although the definition of the attributes are derived from the Concept Register.