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DRAFT S-100 and CMDS Terminology

# Summary

Although within the ENAV Committee S-100 and CMDS are central to the implementation of e-navigation, an understanding of the correct terminology is not yet mature. It is therefore beneficial to provide definitions of their associated terminology.

## Purpose of the document

This document aims to enhance clarity, understanding and hence assist consistency in the use of the correct terminology associated with S-100 and CMDS (Common Maritime Data Structure).

## Related documents

See Section 4.

# Background

In November 2014 the Maritime Safety Committee (MSC) of the IMO (International Maritime Organization) approved the E-navigation Strategy Implementation Plan (SIP). [Ref 1]

Sub-solution S4.1.1 of the SIP [appendix 1] identifies the need to ‘Implement a Common Maritime Data Structure and include parameters for priority, source, and ownership of information’. It also notes that ‘It has been already agreed to use the IHO S-100 data model’.

Furthermore the sub-solution notes the requirement to ‘Develop both the shore based data models and also the shipboard data models including firewalls, as necessary, and harmonize via the IMO-IHO harmonization group on data.’ Terms of Reference for this harmonisation group have been agreed, but the group has not yet been formed.

The IHO standard S-100, the Universal Hydrographic Data Model, was published in January 2010.

‘S-100 provides a contemporary hydrographic geospatial data standard that can support a wide variety of hydrographic-related digital data sources, and is fully aligned with mainstream international geospatial standards, in particular the ISO 19100 series of geographic standards, thereby enabling the easier integration of hydrographic data and applications into geospatial solutions.’ [Ref 2]

# Discussion

One of the principles of S-100 is that it allows the creation of separate registers for different user communities. IALA is one of these communities, having the intention of publishing its own suite of S-100 product specifications. It is therefore important that IALA understand and use terminology consistent with the S-100 standard.

The definitions below aim to enhance understanding within IALA care must be taken not to develop two definitions for the same thing and to ensure that the definitive source of the definition is recognised. Ultimately a terminology register may be useful for e-Navigation in the wider sense.

## S-100 Terminology

S-100 terminology is reasonably mature, having been published in 2010 [Ref 2], and being used by various development groups within and beyond the IHO. Annex A of S-100 ‘Terms and Definitions’ is the definitive document containing much more detail and which should be referred to for further clarification. This in turn refers as appropriate to ISO 19104 *Geographic information – Terminology* and other standards within the ISO19000 series.

The following table is not exhaustive, but provides definition of the main terms used in S-100. Many of these are not exclusive to S-100, but are provided within this context.

1. S-100 Terminology

|  |  |  |
| --- | --- | --- |
| **Term** | **Definition** | **Example** |
| S-100 [Ref 2] | IHO Universal Hydrographic Data Model.  The overarching definition of the standard, providing the framework of components that are based on the ISO 19100 series of standards and specifications.  S-100 details the standard to be used for the exchange of hydrographic and related geospatial data between organizations, and for its distribution to manufactures, mariners and other data users. |  |
| S-1xx; S-2xx | S-100 based product specifications.  The first numeral indicates the following allocated domains:   * 101-199 IHO * 201-299 IALA * 301-399 IOC * 401-499 Other organizations |  |
| S-99 [Ref 3] | IHO standard: Operational Procedures for the Organization and Management of the S-100 Geospatial Information Registry |  |
| Data Product | In S-100 these are geographic data products for hydrographic requirements.  ISO 19131:2008 states:   * **data product**, **dataset** or **dataset series** that conforms to a **data product specification** * **dataset -** identifiable collection of data   **dataset series** collection of **datasets** sharing the same product specification |  |
| Product Specification | A description of all the features, attributes and relationships of a given application and their mapping to a dataset. It is a complete description of all the elements required to define a particular geographic data product. A product specification, defined at a given date, may reference an item in the register at a specific point in time.  ISO 19131:2008 states:   * **data product specification -** detailed description of a **dataset** or **dataset series** together with additional information that will enable it to be created, supplied to and used by another party.   NOTE A data product specification provides a description of the universe of discourse and a specification for mapping the universe of discourse to a dataset. It may be used for production, sales, end-use or other purposes. | S-101 ENC product specification |
| Universe of discourse | view of the real or hypothetical world that includes everything of interest  [ISO 19101] |  |
| Registry | S-100 is underpinned by a Registry and component Registers based on ISO 19135. The GI Registry is owned by the IHO and managed and hosted by the IHB (The IHO Secretariat). The administration of the Registry conforms to IHO S-99.  The Registry consists of five types of Registers | IHO Geospatial Information Registry |
| Register | A list or dictionary of items.  Selections from the **Feature Concept**, **Portrayal** and **Metadata Registers** are used to define Feature and Portrayal Catalogues used in individual Product Specifications.  The **Product Specification Register** is a list of S-100 based Product Specifications created by recognized organizations describing meta information about the content, purpose, version, location and availability of those Product Specifications.  The **Data Producer Code Register** is the authoritative list of the codes which can, if required, be stipulated in Product Specifications to identify the producers of a particular data product. | Feature Concept Register  Portrayal Register  Metadata Register  Product Specifications Register  Data Producer Code Register |
| Domain | well-defined set [ISO/TS 19103:2005] | Hydrographic  AtoN, Meteorological |
| Domain Owner | Any recognized organization can propose a new domain.  Within the Feature Concept, the Portrayal and the Metadata Registers each entry is assigned to a recognised domain. The purpose of designating domains and a related Domain Control Body is to ensure that the key stakeholders (as represented by the domains) are consulted in any subsequent proposals to adjust items contained in a Register. | IHO  IALA |
| Submitting Organisation | Submitting Organizations propose changes and additions to the contents of Registers.  Submitting Organizations will normally represent a recognized body or stakeholder group (such as from government, industry, academia, and relevant user groups).  Registered submitting organizations may submit proposals for consideration under any domain in a register.  Stakeholders and any other interested parties who do not wish to enrol should submit proposals through an existing Submitting Organization. | Inland ENC Organization |
| Feature | ISO 19131:2008 states:   * feature - abstraction of real-world phenomena [ISO 19101]   NOTE A feature may occur as a type or an instance. Feature type or feature instance shall be used when only one is meant.  EXAMPLE: The feature instance named “Eiffel Tower” may be classified with other phenomena into a feature type “tower”. | Bridge, Buoy, Obstruction,  Foul ground |
| Attribute | Attribute - named property of an entity  NOTE: Describes the geometrical, topological, thematic, or other characteristic of an entity.  Feature attribute - characteristic of a feature [ISO 19101]  NOTE 1: A feature attribute may occur as a type or an instance. Feature attribute type or feature attribute instance is used when only one is meant.  NOTE 2: A feature attribute type has a name, a data type and a domain associated with it. A feature attribute for a feature instance has an attribute value taken from the domain.  Attributes may be simple type or complex type. | Category of obstruction, Condition, |
| Complex attribute | Complex attributes are aggregates of other attributes that can be simple type or complex type. | e.g. Topmark with sub-attributes, Colour, shape and Shape information |
| Enumerated value | Each simple attribute is assigned to one of 8 types: One of these types is: EN - Enumeration: A fixed list of valid identifiers of named literal values.  Attributes of an enumerated type may only take values from this list.  Enumeration - A fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list. | e.g. Visually conspicuous  1 : visually conspicuous  2 : prominent  3 : not visually conspicuous |
| Spatial Geometry | Simple geometry based on three criteria – complexity, dimensionality and functional complexity. The first two criteria (complexity and dimensionality) determine the types defined in this profile that shall be implemented according to an application schema that conforms to a given conformance option.  There are two levels of complexity:  1) Geometric Primitives  2) Geometric Complexes,  four levels of dimensionality:  1) 0-dimensional objects  2) 0- and 1-dimensional objects  3) 0-, 1- and 2-dimensional objects  4) 0-, 1-, 2- and 2½ -dimensional objects |  |
| 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 feature concept dictionaries and binds them together. In addition, constraints, units of measurement and format description of attributes can be specified.  The data product specification shall include a feature catalogue, which provides a full description of each feature type including attributes, attribute values and relationships in the data product. The feature catalogue shall be realized in accordance with S-100 Part 5. The feature catalogue shall be available in both ‘machine readable’ (e.g. XML based on the S-100 Feature Catalogue XSD) and ‘human readable’ (e.g. textual derived by XSLT from the XML) forms.  All the feature types, their attributes and attribute value domains, and the association types between feature types expressed in the application schema shall be described in a feature catalogue. | S-101 Feature Catalogue |
| Feature Concept Dictionary | A feature concept dictionary specifies independent sets of definitions of features, attributes, enumerated values, and information types that may be used to describe geographic, hydrographic, and metadata information. A feature concept dictionary may be used to develop a feature catalogue. Unlike a feature catalogue, a feature concept dictionary does not make associations or bind attributes to features.  Features and attributes that are defined in a feature concept dictionary shall be bound in a feature catalogue. | S-100 GI Registry |
| Portrayal | ISO 19131:2008 states:   * Portrayal: presentation of information to humans [ISO 19117]   (i.e. what it looks like) | S-101 Portrayal Catalogue |
| Application schema | A basic part of any S-100 based product specification.  ISO 19131:2008 states   * application schema: conceptual schema for data required by one or more applications * conceptual schema: formal description of a conceptual model * conceptual model: model that defines concepts of a universe of discourse * model: abstraction of some aspects of reality * application: manipulation and processing of data in support of user requirements   The data product specification shall contain an application schema. For all data product specifications in the realm of S-100, the application schema shall be expressed in UML. All other rules of S-100 Part 2 concerning the creation of the general feature model and especially conformance to ISO 19109:2005 apply as well. If the application schema is a separate document, then the product specification shall include a narrative summary. |  |
| Metadata | ISO 19131:2008 states:   * metadata: data about data [ISO 19115] | Content, quality, extent, date, ownership |
| UML | The **Unified Modeling Language** is a general-purpose [modeling language](http://en.wikipedia.org/wiki/Modeling_language) in the field of [software engineering](http://en.wikipedia.org/wiki/Software_engineering), which is designed to provide a standard way to visualize the design of a system. |  |
| XML | **Extensible Markup Language** (**XML**) is a [markup language](http://en.wikipedia.org/wiki/Markup_language) that defines a set of rules for encoding documents in a [format](http://en.wikipedia.org/wiki/File_format) which is both [human-readable](http://en.wikipedia.org/wiki/Human-readable_medium) and [machine-readable](http://en.wikipedia.org/wiki/Machine-readable_data). |  |
| GML | **Geography Markup Language**.  GML is an XML grammar for encoding geographic information. GML application schemas are written using XML Schema Definition Language which is itself a form of XML. Specific rules for designing GML application schemas using UML Class Diagrams are presented in ISO 19136 (the ISO/TC 211 standard for GML). | S-100 gives guidance on GML (ISO 19136) encoding; a given product would have a specific GML application schema, expressed in one or more XML Schema |
| Encoding format | encoding : Conversion of data into a series of codes [ISO 19118].  The international standard ISO/IEC 8211 - Specification for a data descriptive file for information interchange, is a means of encapsulating data; it provides a file based mechanism for the transfer of data.  An interchange format to facilitate the moving of files containing data records between computer systems. It defines a specific structure which can be used to transmit files containing data type and data structures specific to S-100. | e.g. ENC datasets - ISO/IEC 8211 encoding |
| Exchange set | an aggregation of all the various elements required to support the interchange of geospatial data and metadata |  |

## CMDS Terminology

The Common Maritime Data Structure (CMDS) is a concept within the IMO SIP, but has not yet been implemented in any formal or internationally agreed manner. The terminology is therefore not yet mature. Various-navigation test-beds demonstrate some of the principles.

The following terms are not exclusive to CMDS.

1. CMDS Terminology

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| --- | --- | --- |
| Term | Definition | Example |
| CMDS | Common Maritime Data Structure |  |
| System Architecture | The [conceptual model](http://en.wikipedia.org/wiki/Conceptual_model) that defines the [structure](http://en.wikipedia.org/wiki/Structure), (components), [behavior](http://en.wikipedia.org/wiki/Behavior), and relationships both within and external to a system.  This may be in the form of a formal description to support an understanding of the relative functionality of components (sub-systems). | the CMDS diagram within the SIP [appendix 2] |
| Operational Service | The manifestation of a service within the operational environment.  The definition of that service from the users perspective, defined in terms of user requirements and operation. | See MSP |
| Functional link | The abstract definition of data/information exchange between systems with no regard to the physical link. |  |
| Physical link | The technology used to exchange data/information between systems | telecommunications |
| MSP | **Maritime Service Portfolio** as defined within the IMO Strategy Implementation Plan, identified as the means of providing electronic information in a harmonized way. | VTS Information Service |

# References

1. IMO paper NCSR 1/28 (16 July 2014), Annex 7 - E-navigation Strategy Implementation Plan (as referred to in para 9.8 of the same paper.
2. S-100 IHO Universal Hydrographic Data Model (January 2010). Available at [www.iho.int/iho\_pubs/IHO\_Download.htm](http://www.iho.int/iho_pubs/IHO_Download.htm)
3. S-99 Operational Procedures for the Organization and Management of the S-100 Geospatial Information Registry (Ed. 1.1.0, November 2012) Available at [www.iho.int/iho\_pubs/IHO\_Download.htm](http://www.iho.int/iho_pubs/IHO_Download.htm)
4. ISO 19104:2008 *Geographic information – Terminology*

# Action requested of the Committee

The Committee is requested to:

1. Note the content of this paper and endeavour to use consistent and appropriate terminology.
2. Contribute to its continued development
3. CMDS definition
4. SIP Sub Solution 4.1.1

Sub-solution 4.1.1 from the IMO SIP [Ref 1] provides the following reference to the CDMS.

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| **S4.1.1** | Implement a Common Maritime Data Structure and include parameters for priority, source, and ownership of information. | CMDS is at the heart of e-navigation. It has been already agreed to use the IHO S-100 data model. Develop both the shore based data models and also the shipboard data models including firewalls, as necessary, and harmonize via the IMO-IHO harmonization group on data |

1. CMDS Diagram.
2. Common Maritime Data Structure diagram

The IMO SIP [Ref 1] provides the following diagram as a description of the CMDS concept.

