IHO S-100 -
The New Hydrographic Geospatial Standard for Marine Data and Information

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Introduction

The International Hydrographic Organization (IHO) is an intergovernmental consultative and technical organization established in 1921 to support the safety of navigation, and to contribute to the protection of the marine environment. One of its primary roles is to establish and maintain appropriate standards to assist in the proper and efficient use of hydrographic data and information.

This paper describes the new IHO Geospatial Standard for Hydrographic Data to be known as S-100, together with the Geospatial Information Infrastructure (GII) that is in the course of development and implementation by the IHO. In both cases, details have yet to be finalised – for example, the first draft of S-100 – IHO Geospatial Standard for Hydrographic Data was only released for stakeholder comment in March 2008 and S-100 is not expected to be an active standard until at least 2009 or 2010. Nevertheless, the concepts and supporting organisational framework behind the GII are already beginning to take shape.

The purpose of this paper is to draw attention to what is happening and thereby promote comment and the active involvement of both existing and potential stakeholders in the development and implementation of both the IHO GII and S-100.

Background

IHO Publication 57 (IHO S-57) is the IHO Transfer Standard for Digital Hydrographic Data. The standard was formally adopted as an official IHO standard in 1992. It purpose was for the exchange of digital hydrographic data between hydrographic offices, and for the distribution of hydrographic data to manufacturers, mariners and other data users (e.g., environmental management organizations). It was developed so that the transfer of all forms of hydrographic data would take place in a consistent and uniform manner. However, to date, S-57 has been used almost exclusively for encoding Electronic Navigational Charts (ENCs) for use in Electronic Chart Display and Information Systems (ECDIS).

While S-57 was intended to support all types of hydrographic data, customers and the technology for hydrographic data, this has not happened. One of the reasons for this is that S-

57 is not a contemporary standard that is widely accepted in the GIS domain. Accordingly, the IHO has embarked on the development of a new, more versatile standard – S-100 – that will comply with the ISO 19100 series of geographic information standards being developed by ISO Technical Committee 211. S-100 should therefore form an attractive basis upon which a wide range of digital products and transfer standards for hydrographic and related applications can then be developed in the future.

Goals for S-100

The primary goal for S-100 is to support a greater variety of hydrographic-related digital data sources, products, and customers. This includes matrix and raster data, time-varying data (x, y, z, and time), and new applications that go beyond the scope of traditional hydrography (for example, high-density bathymetry, seafloor classification, marine GIS). It will also enable the use of web-based services for acquiring, processing, analyzing, accessing, and presenting data. S-100 is not an incremental revision of the current Edition 3.1 of S-57. S-100 will be a new standard that includes both additional content and support of new data exchange formats.

Due to the worldwide prominence of ISO standards, IHO S-100 will be based on the ISO suite of standards. However, alignment with the ISO 19100 series of geographic standards will require a different structure for S-100 compared to S-57. More specifically, this will involve a new framework, and new/revised terms to describe the components of S-100.

S-100 was released as a draft version in February 2008. It is therefore in the development and testing phase. Meanwhile, IHO S-57 Edition 3.1 will continue to be used for many years to come -- even after S-100 becomes an active standard. As such, Hydrographic Offices will continue to produce S-57 ENC data to meet IMO ECDIS Performance Standard requirements, and to maintain world-wide ENC coverage. Any future ENC Product Specification will take several years to develop after publication of the S-100 base standard, and will involve the active participation of all IHO stakeholders.

History of S-57

IHO Special Publication 57 (IHO S-57) is the IHO Transfer Standard for Digital Hydrographic Data. It is the established standard for the exchange of digital hydrographic data between hydrographic offices, and for the distribution of hydrographic data to manufacturers, mariners and other data users (e.g., environmental management organizations). It was developed so that the transfer of all forms of hydrographic data would take place in a consistent and uniform manner. To date, S-57 has been used almost exclusively for encoding Electronic Navigational Charts (ENCs) for use in Electronic Chart Display and Information Systems (ECDIS). Although S-57 was originally intended to support all types of hydrographic data, it is now realized that it has limitations. There is a need for a new standard capable of accommodating new requirements.

IHO S-57 was formally adopted as an official IHO standard at the 14th International Hydrographic Conference in May 1992. It includes:

- A general introduction with list of references and definitions
- A theoretical data model on which the standard is based
- The data structure and format that are used to implement the data model
- General rules for encoding data into the ISO 8211 encapsulation

In addition to the main document, there are two appendices:

- <u>Appendix A</u> is the Object Catalogue. It provides the official, IHO-approved data schema that can be used within an exchange set to describe real-world entities.

- <u>Appendix B</u> contains the IHO-approved Product Specifications. These contain additional sets of rules for specific applications. Currently, the only product specification in S-57 that is in wide use is for an Electronic Navigational Chart (ENC). A product specification for an IHO Object Catalog Data Dictionary was also included but for all practical purposes has never been implemented.

S-57 Edition 3.0 was released in November 1996. Edition 3.1 containing minor revisions and some additional attribute values was issued in November 2000. Currently, S-57 3.1 is "frozen". It will remain valid until no longer required.

A Supplement to Edition 3.1, designated S-57 Edition 3.1.1 came into effect in January 2007 to include the new features and attributes required to enable the encoding of the recently introduced Archipelagic Sea Lanes, Environmentally Sensitive Sea Areas (ESSA) and Particularly Sensitive Sea Areas (PSSA) by the IMO. The inclusion of the Supplement avoided the need to release a new edition of S-57 and the consequential effects on both data producers and equipment manufacturers. The Edition 3.1.1 Supplement operates concurrently with S-57 Edition 3.1 and is available solely for the use of those data producers that need to include the new features.

Current Limitations of S-57 Edition 3.1

Although S-57 Edition 3.1 has many good aspects, it does have limitations:

- It was primarily developed to meet the ENC requirement called for in an IMO-compliant ECDIS.

- It has an inflexible maintenance regime. Freezing standards for lengthy periods is counter-productive.

- As presently structured, it cannot support future requirements (e.g., gridded bathymetry, or time-varying information).

- Embedding the data model within the encapsulation (i.e., file format) restricts the flexibility and capability of using a wider range of transfer mechanisms.

- It is regarded by some as a limited standard focused exclusively for the production and exchange of ENC data.

In order to address these and other limitations, the IHO Committee on Hydrographic Requirements for Information Systems (CHRIS) authorised work to begin on a major revision of Edition 3.1. This revision will result in a new standard that includes both additional content and a new data exchange format. The draft version was released in early 2008 as part of the development and testing phase for the standard (see also diagram 4).

New Name – S-100

During the years that S-57 has been in use, many people have come to regard the IHO S-57 standard and the ENC Product Specification as the same thing. In reality, the ENC Product Specification is, in effect, the specific implementation of S-57 for the purpose of producing an ENC for use in ECDIS. This resulted in the impression by many within the ECDIS and ENC community that the work on a new S-57 Edition 4.0 standard that would better support other hydrographic products as well as ENCs would radically change the current ENC, thus

affect existing ENC production and ECDIS implementation. This was not the intention.

In 2005 the IHO decided that the S-57 Edition 4.0 that was currently under development would henceforth be designated as S-100 - IHO Geospatial Standard for Hydrographic Data. Any product specifications developed using S-100 would then follow in an S-10x series as they are produced. Under this schema, at some future date when a next-generation ENC Product Specification based on S-100 is developed, it will be designated S-101.

Goal/Objectives for S-100

The primary goal for S-100 is to be able to support a greater variety of hydrographic-related digital data sources, products, and customers (see Figure 1). This includes imagery and gridded data, 3-D and time-varying data (x, y, z, and time), and new applications that go beyond the scope of traditional hydrography (for example, high-density bathymetry, seafloor classification, marine GIS, etc.). It will also enable the use of Web-based services for acquiring, processing, analysing, accessing, and presenting data.
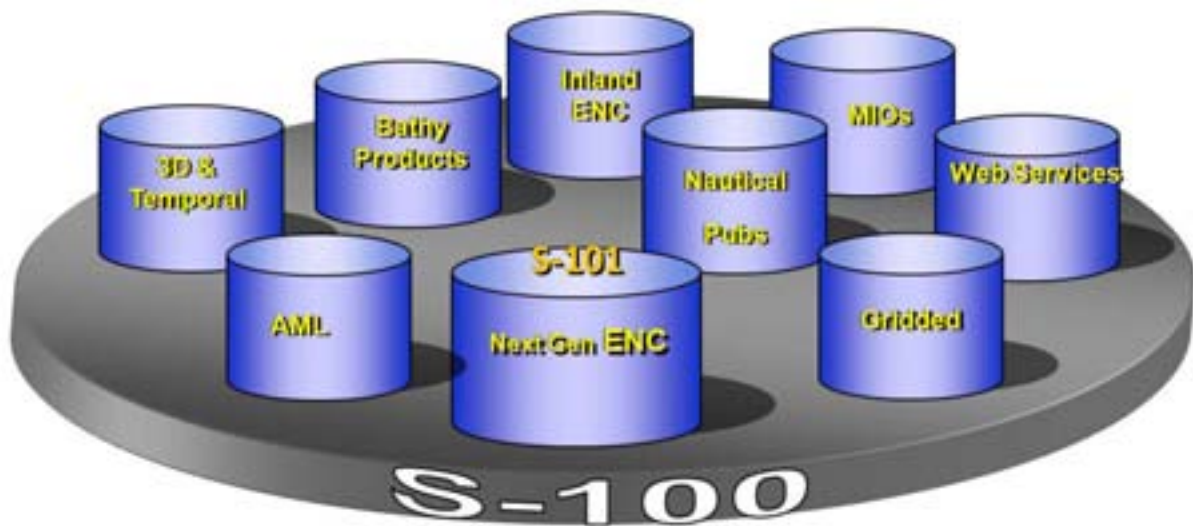

Figure 1 - S-100 will support a far greater variety of data sources, products and services

Other goals include:

- Separating the data content from the carrier (file format). In this way, data can be manipulated and encoded without being permanently tied to a single exchange mechanism.

- Manageable flexibility that can accommodate change. The content of future product specifications will be a subset of S-100, including separate feature catalogues. This will allow the core standard to evolve (through extension) without the need to introduce new versions of product specifications.

- An ISO-conforming registry on the IHO Web site containing registers for Feature data dictionaries, portrayal and metadata. The registers will accommodate both core hydrographic content and other chart related content, such as, Nautical Publications, Inland ENC and Marine Information Overlays.

ISO Standards for Geographic Information

The International Organization for Standardization (ISO) is a non-governmental international standards organization comprising a worldwide federation of national standards bodies from

over 130 countries. In response to a growing demand for geographic information standards, ISO established Technical Committee 211 (ISO/TC211) in 1994. The aim of ISO/TC211 is to establish a structured set of standards for information concerning geographic objects or phenomena. IHO, together with many other geographic standards development organizations, is a Class-A Liaison Organization to ISO/TC211. Currently, there are over 22 Class-A members, including:

- Digital Geographic Information Working Group (DGIWG),

- Global Spatial Data Infrastructure (GSDI),

- Open Geospatial Consortium (OGC),

- United Nations Geographic Information Working Group (UNGIWG).

ISO 19100 Standards

The standards developed by ISO/TC211 are contained in the ISO 19100 series of geographic information standards. For all forms of geographic data, these standards specify the methods, tools, and services for:

- Data management (including definition and description),

- Acquiring, processing, analysing, accessing, and presenting data,

- Transferring data in digital electronic form between different users, systems and locations.

In the most general sense, these standards fall into one of the following categories:

- Framework and Reference Model,

- Profiles and Functional Standards,

- Data Models and Operators,

- Data Administration,

- Geographic Information Services.

Currently, there are over 40 standards in the ISO 19100 series. These include both formally adopted and draft International Standards for spatial and temporal schema, metadata, imagery and gridded data, profiles, portrayal, encoding, and so forth.

Alignment with ISO/TC211

Given the prominence of ISO standards and their worldwide recognition and use, it makes sense for IHO to adopt the ISO/TC211 suite of standards for S-100.

In 1999, ISO/TC211 invited the IHO and the NATO Digital Geographic Information Working Group (DGIWG) to enter into a cooperative agreement for future standards development. Rather than work at cross-purposes, it was considered prudent to harmonize the data content contained in IHO S-57 (i.e., the Object Catalogue) with that of NATO DIGEST (the DGIWG Feature Data Dictionary – formerly called Feature Attribute Coding Catalog or FACC). Further, the intent was to develop hydrographic standards that were compatible with a broad range of other ISO geospatial standards. This was agreed by the 12th CHRIS meeting in October 2000. Currently members of both organizations attend each other's meetings and have played important roles in the harmonization process.

S-100 Framework

S-100 comprises multiple components that will be aligned with the ISO 19100 series of geospatial standards. Developing S-100 in this way will enable hydrographic data to be included in many more general geospatial applications as well as in the traditional hydrographic domains.

Alignment with the ISO 19100 series of geographic standards will require that S-100 is organized and defined in a different way when compared to S-57. More specifically, it will require a new framework or structure, and a revised set of terms to describe the components of S-100. Proposals to achieve this are described later in this paper.

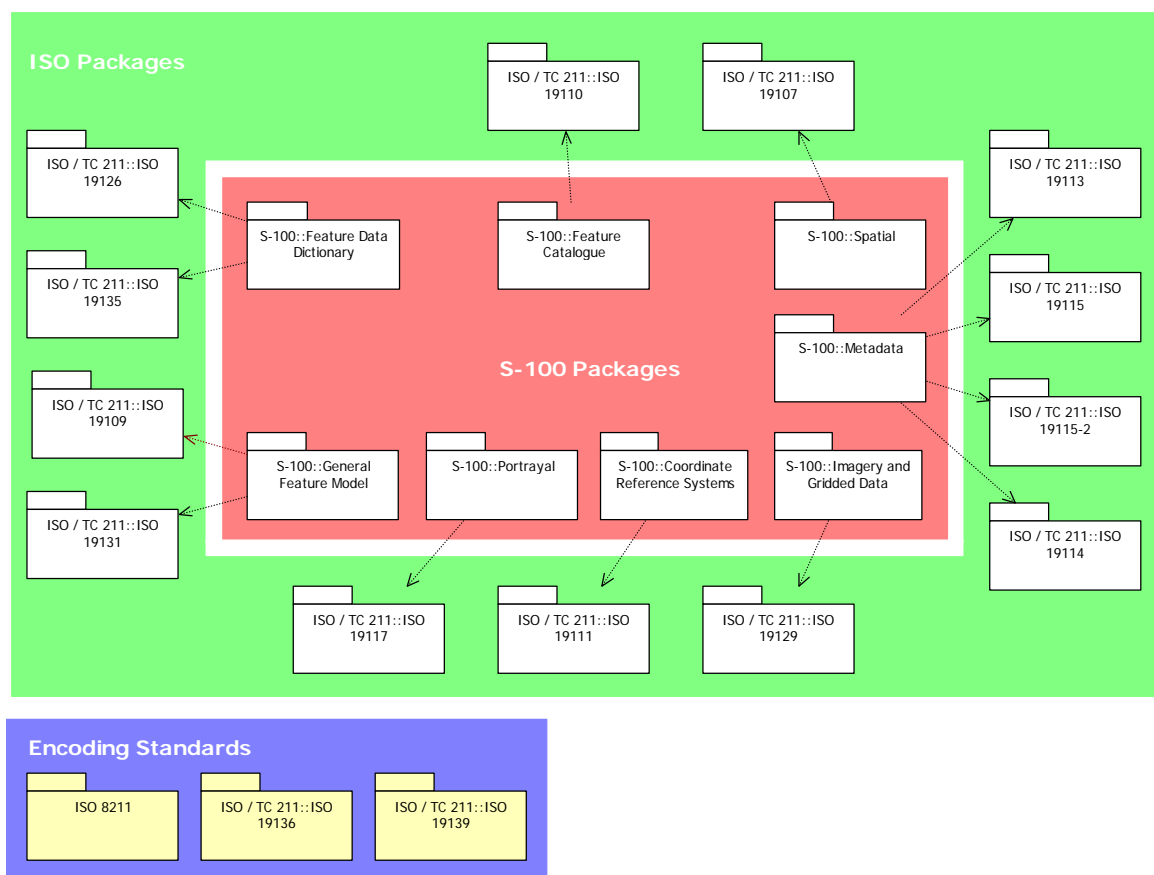The relationship between S-100 work packages and their ISO base classes is shown in Figure 2.

Figure 2 - IHO S-100 Components and their Associated ISO Standards

Registry Component

Perhaps the most significant aspect in terms of alignment with the ISO TC/211 standards is the employment of a "Registry" containing one or more "Registers" (see Figure 3).
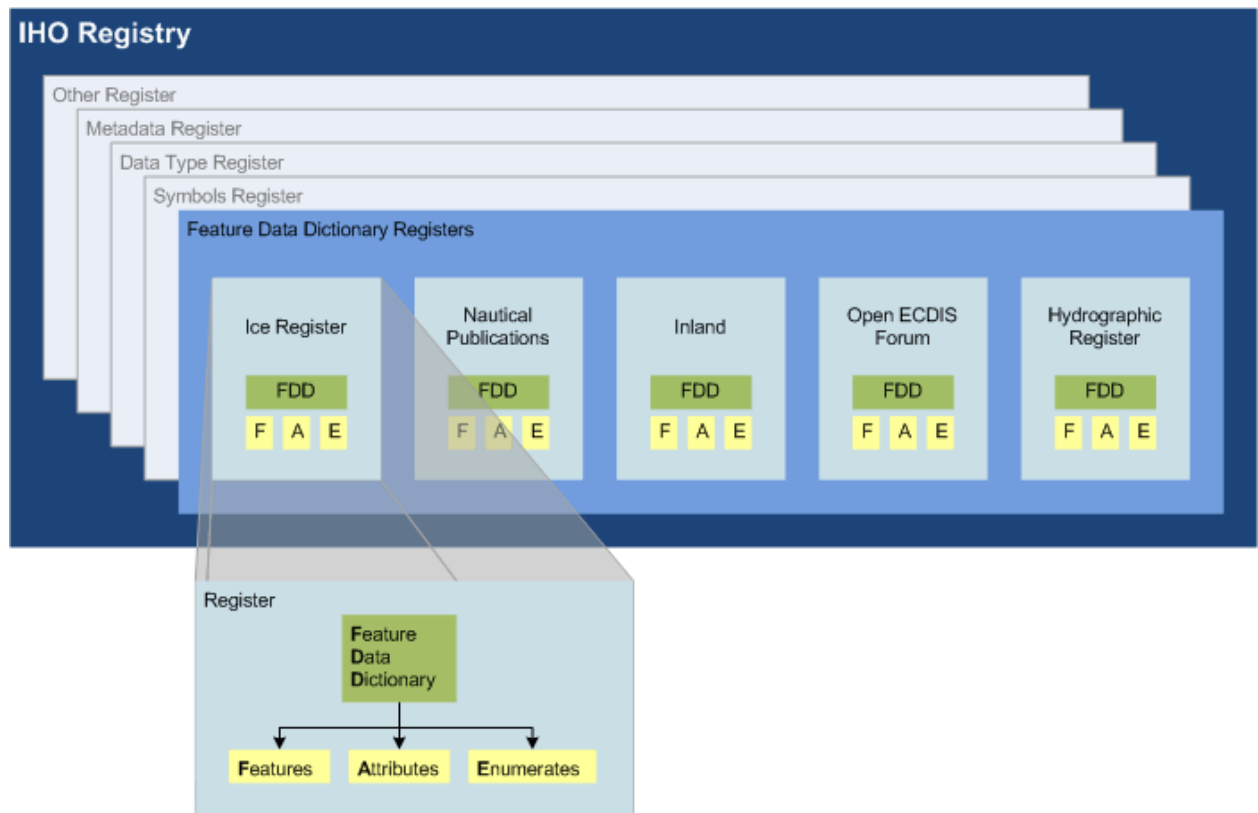

Figure 3 – The IHO Registry for S-100 will comprise a collection of Registers

A "Registry" is the entire information system (or location) in which a collection of Registers is located. In the case of S-100, IHO will host a Registry that will provide a facility to store various Registers of hydrographic-related information such as feature data dictionaries, data types, and metadata.

Unlike S-57, the feature dictionaries will only consist of the definitions for Features, Feature Attributes and enumerations. Binding between these definitions, units of measure, format and so on, will be included in a Feature catalogue which will be specific to each product specification. Initially there will be Registers for Hydrographic Information (based on the existing S-57 Feature and Attribute catalogues), Dynamic Ice Coverage, Nautical Publications and Inland ENCs. Other types of information that do not fit into these categories may be included in the Open ECDIS Forum (OEF) Register. For each Register there will be an organization that will be responsible for its content and management. A major benefit of the Registry concept is its flexibility. Multiple versions of similar entries in a data dictionary can be maintained using unique identification and classification. For instance, an entry can be classified as being either:

- valid (latest version)

- superseded (previous version/s)

- retired (no longer recommended for use)

- non valid (proposed but not accepted or no longer acceptable)

In this way Product Feature Catalogues will reference items that will always remain valid even if a newer version of the referenced item is registered at a later date. This means that if a new item is registered or an existing item is upgraded, new versions of existing product specifications are not required. *Non valid* items will be visible in the Registers to ensure that any future proposals for similar items have not been previously rejected. The S-100 Registry entered into use in 2007 when the IHO Standardisation of Nautical Publications Working Group and the Inland ECDIS Harmonization Group began populating Registers with relevant information in support of Digital Nautical Publications and Inland ENCs respectively.

Metadata Component

Increasingly, hydrographic offices are collecting, storing and archiving large quantities of digital data which are becoming an important national asset. Knowledge of the quality of hydrographic data is crucial in ensuring that the data is used appropriately; different users and different applications often have different data quality requirements. In order to provide relevant details, data custodians will need to record quality information about their data. This will be at least one part of a metadata requirement.

The S-100 metadata component makes provision for the creation of metadata records that provide information about the identification, spatial and temporal extent, quality, application schema, spatial reference system, and distribution of digital geographic data. It is applicable to the cataloguing of datasets, clearinghouse activities, and the full description of geographic and non-geographic resources. Although it is primarily intended to describe digital geographic data, it may also be used to describe other resources such as charts, maps, textual documents and non-geographic resources.

Feature Catalogue Component

This component provides improved flexibility including:

- feature catalogues for individual product specifications can be constructed using either items referenced from the Data Dictionary Registers or new items defined in the catalogue itself.

- decisions about the binding between Features and Feature Attributes will be defined in the individual catalogue along with the unit of measure for numeric attributes.

- a new Information Type is introduced which does not have any spatial attribution and will provide information about a feature by association. This could be a note associated with a pipeline or a buoy, for example.

- a new complex attribute type is introduced. This is an extension of the ISO concept of an Attribute of an Attribute.

Spatial Component

The one and two-dimensional geometry of S-57 is being updated in S-100 to accommodate the use of a wider range of database and encoding applications. For example, the use of a composite curve to consolidate the individual curve components of a feature will simplify operations on such a feature in the software environment. Surfaces are being introduced to solve issues of area features truncated by data boundaries. This will accommodate the encoding of one area feature with one set of geometry, unlike in S-57 where several features

using individual geometries are required to model what is actually a single feature.

Imagery and Gridded Component

This component defines specific grid organizations to be used for hydrographic data and images associated with hydrographic data. Both simple grids and complex multi-dimensional grids are defined.

Hydrographic soundings are by their nature a set of measured data points. These data points can be represented in a grid structure in several different ways, including elevation models, using a regular grid spacing, and irregular grids with variable size cells or picture elements (pixels) that closely correspond to the handling of soundings as point sets.

Images are also of great importance for hydrographic data. This includes images from sensors such as aerial photography or LIDAR, photographs that can be associated with vector based feature oriented data and scanned paper chart products, commonly known as "raster Charts." All of these applications of imagery and gridded data will be catered for in S-100.

Encoding Component

S-100 itself will not mandate particular encoding formats. This means that the developers of Product Specifications can decide on the suitable encoding standard for their particular applications

Initially S-100 will only provide an updated schema for ISO 8211 and schemas for GML including a version for Simple Features for use in web feature services. This will eventually be extended to include other formats as and when required.

Product Specification Component

A Product Specification is 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.

This component is intended to ensure that any data product specification will maintain a similar structure.

A product specification consists of the following basic parts:

- product identification.
- data content and structure
- coordinate reference system.
- data quality
- data capture
- data maintenance
- portrayal
- encoding
- product delivery

Maintenance Component

S-100 will never be "frozen" although the frequency of new versions will be strictly controlled by the IHO as the Registry Owner. There will be three types of change proposal in S-100: clarification, correction and extension. Any change proposal must be one of these types.

The maintenance regime has been changed considerably in comparison to that in S-57. The concept of a change being both a clarification and a correction has been removed. The new version control mechanism will be as follows:

- Clarifications denoted as 0.0.x.

- Corrections denoted as 0.x.0.

- Extensions denoted as x.0.0.

New Terminology (IHO S-57 → IHO S-100)

Some of the terms and definitions currently used in S-57 Ed. 3.1 will not be used in S-100. They will be re-defined or modified to conform with the same terms used in the ISO TC/211 series of standards.

Some examples of the changes in terminology include:

S-57 Ed. 3.1	IHO S-100
[no term used] * The closest thing to a registry/registers that currently exists are the arrangements on the Open ECDIS Forum (OEF). During the past six years, it has served as a useful mechanism/database for registering additional objects/attributes that were not contained in S-57 Edition 3.0/3.1.	registry register
object	feature
attribute	feature attribute
attribute values	enumerated values
object catalogue	feature data dictionary
edge	curve
node	point
face	surface
application profile	application schema

Benefits

There are many benefits to be gained from adopting S-100:

- Using ISO-developed components and terminology will help ensure that S-100 and future extensions are in the mainstream of the geospatial information industry. This should also help to encourage a greater use and thereby lower costs in implementing S-100 for hydrographic and other types of geospatial applications (for example, Marine GIS).

- Conformance with the ISO/TC211 standards will maximize the use of commercial-off-the-shelf (COTS) software applications and development.

- New components of S-100 will not be developed in isolation from the rest of the geospatial information technology community.

- Any new requirements can be incorporated within the established framework of ISO/TC211 based standards.

- Rather than being regarded as simply a standard for hydrography, S-100 will be interoperable with other ISO/TC211 standards and profiles such as NATO DIGEST.

- There are many national standards bodies that will take full advantage of S-100 being aligned with ISO/TC211 standards.

- Compatible hydrographic data will be available to more than just hydrographic offices and ECDIS equipment.

- It will enable hydrographic offices to use compatible sources of geospatial data, for example combining topography and hydrography to create a coastal zone map.

Migrating from S-57 Edition 3.1 to S-100

ENC data conforming to S-57 Edition 3.1 will continue to be a requirement for type-approved, IMO-compliant ECDIS for the foreseeable future - even after S-100 has been released. As a consequence, hydrographic offices will continue, as at present, to produce Edition 3.1 ENC data to support this.

Implications for the ENC Product Specification

It goes without saying that if any improved ENC Product Specification (such as S-101) is to be adopted in the future, it must provide mariners with useful new functionality. This could include such things as "plug and play" updating of data, symbology and software enhancements as well as the more efficient use of additional data created under S-100.

Also, any development of S-101 will be undertaken over several years, and will involve the active participation of all stakeholders, including hydrographic offices, ENC software producers, ECDIS manufacturers, mariners, and other maritime users. The development, implementation and transition into force must also follow the IHO CHRIS governance model for IHO technical standards as illustrated in Figure 4.
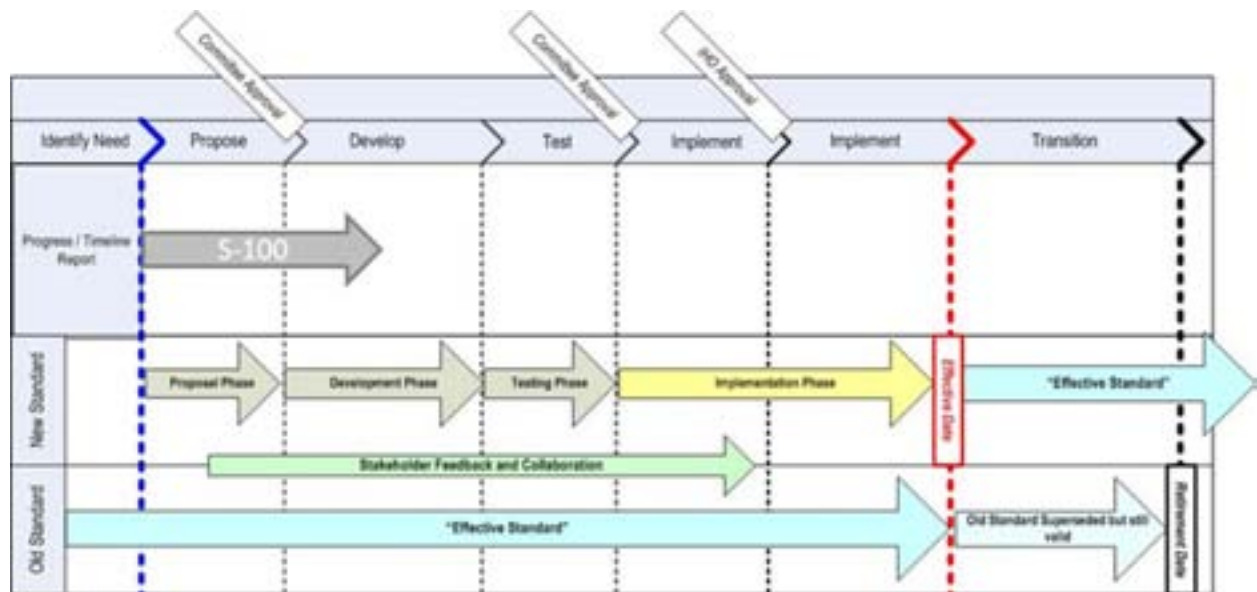
Figure 4 - Typical Lifecycle of an IHO Standard

As a consequence of the extensive development process, any improved ENC Product Specification (S-101) could not come into force before at least 2012 and even then, the standard would sit alongside the existing S-57 Edition 3.1 Product Specification for some time. Furthermore, it is intended that any ECDIS which are upgraded to use S-101 ENCs will continue to be able to use S-57 Edition 3.1 ENCs as well.

S-100 Management and Governance Framework

S-100 will be supported by an organisational and governance framework that will involve all the stakeholder groups. The IHO is the principal sponsor and will have overall control of the standard. However, the development and extension of the standard to meet particular user-group requirements will be placed under the control of those user-groups. This will be achieved through the ownership of the various Registers that form part of the IHO Geospatial information Registry. Each Register will provide a basis for the flexible management of domain specific feature and attribute collections. The IHO – for example, will own Registers for source chart data such as bathymetry, tidal information, chart information and nautical publications. Other owners, such as delegates of the World Meteorological Organization (WMO) will own the Register dealing with data for Sea Ice Reporting; the International Association of Lighthouse Authorities (IALA) may own Registers dealing with collections of Features and Feature Attributes relating to the status of aids to navigation status.

Register Owners

The Registers owned by the IHO will be confined to those that directly support Objects and Attributes (to be known as "Features" and "Feature Attributes" under S-100) that are required to support the official hydrographic products and services required to meet the chart and publications carriage requirements of the Convention on the Safety of Life at Sea (SOLAS).

At the same time, other Registers that can be shown to complement marine navigation or support the activities of national hydrographic authorities could be established in the Registry by the relevant organizations. This could be for such things as Inland ECDIS services, sea ice reports, maritime weather services, and vessel traffic information. In these cases, the relevant competent authority or organisation would control the Register within the rules and procedures of the IHO Geospatial Information Registry as a whole, and would have control

over the compilation and maintenance of their Registers and any Product Specifications that they may wish to derive.

IHO Geospatial Information Registry

At the heart of the GII will be the following Geospatial Information Registries:

> Feature Data Dictionary Registry
>
> Portrayal Registry
>
> Metadata Registry
>
> Agency Code Registry

The IHO Geospatial Information Registry will also contain a Product Specifications Register.

These Registries and the Product Specifications Register will operate through a web-enabled registry engine and database that houses component Registers under each Registry. The Registry interface is currently located at: http://195.217.61.120/iho_registry/
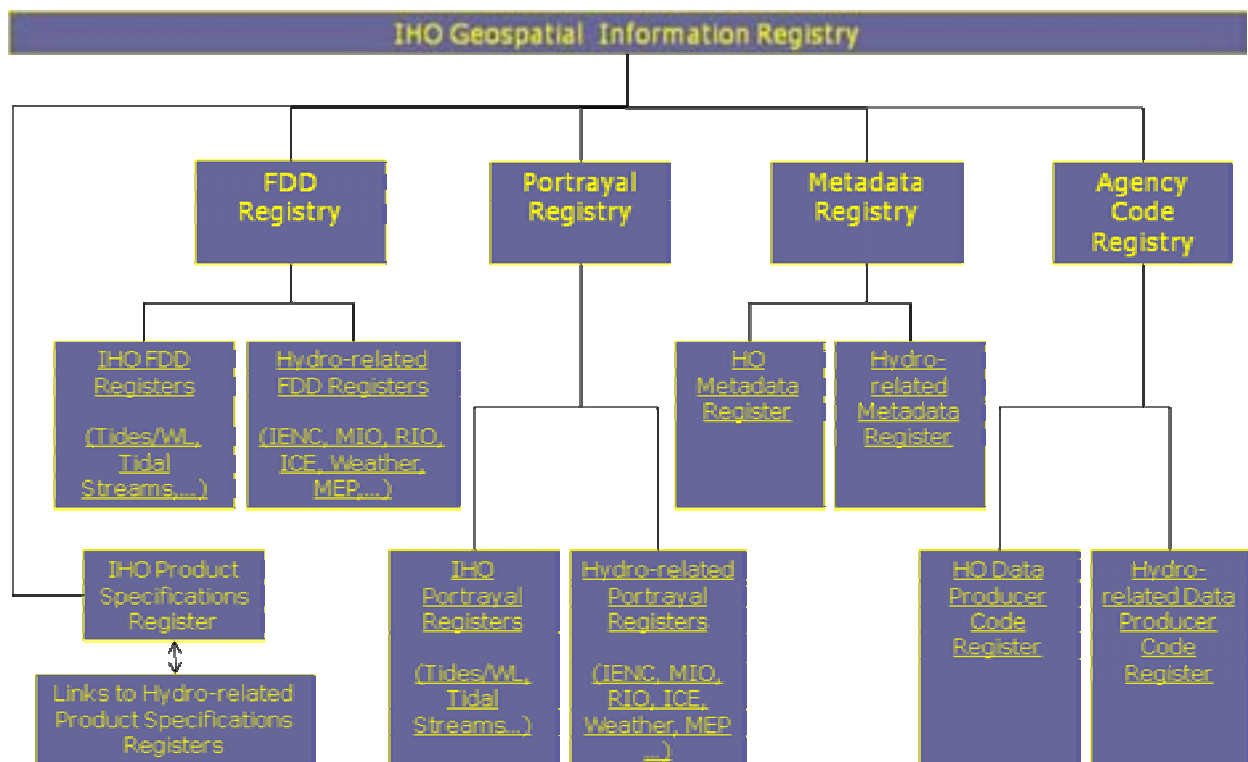

Figure 5 - IHO Geospatial Information Registry

Benefits of the Registry

The establishment of an IHO Geospatial Information Registry will provide particular flexibility in the management of the key product elements that are modelled from real-world entities but are subject to unpredictable change or introduction of new requirements at relatively short-notice. In hydrographic charting this includes such things as new navigational features, specially designated areas and boundaries. These can all be processed and implemented much quicker than previously under S-57.

No registered item is ever removed from any of the S-100 Registers; items will always exist – in one of four states - new, clarified, superseded or retired. This means that there will be no requirement for immediate consequential changes or upgrades to existing Product

Specifications because a revision has been made in a Register to which the Product Specification refers. Presently, such unavoidable consequential changes often result in expensive and time consuming changes to equipment or software that rely on a particular Product Specification. This is the case for ENCs based on S-57 and is the reason why S-57 and the ENC Product Specification have been, in effect, frozen for some time.

Feature Data Dictionary Registry

The Feature Data Dictionary Registry will contain various Registers of feature data dictionaries that specify sets of definitions for Features, Feature Attributes, and enumerated values that may be used to describe geographic information. The feature data dictionaries provide a generic resource for building product specific feature catalogues. The Registry mechanism will enable user communities to build and maintain their feature catalogues and product specifications. Their maintenance will not be dependent on the maintenance of the S-100 base standard or feature data dictionaries, as is presently the case for S-57.

Portrayal Registry

Similar to the FDD Registry, the Portrayal Registry will comprise a number of Registers containing collections of related symbols. Symbol catalogues, including the defining portrayal rules, such as those presently being developed by an ISO/TC211 working group with the active participation from the IHO and DGIWG communities will also be accessible from the Portrayal Registers.

Metadata Registry

Well documented metadata is a key requisite to data discovery. It is anticipated that metadata requirements will extend beyond datasets and service discovery metadata to encompass the documentation of feature and attribute metadata. The Metadata Registry will also contain a Register of metadata definitions.

Agency Code Registry

The Agency Code Registry will contain two Registers – one covering the ENC Producer Codes allocated to national hydrographic authorities for the production of official nautical products and the other covering organizations that are not national hydrographic authorities but have a requirement to associate a producer code with their data.

HO Data Producer Codes Register. The HO Data Producer Codes Register will contain the catalogue of ENC Producer Codes – in effect serving the same purpose as the current IHO Publication S-62 *ENC Producer Codes*. The IHO will be the Owner of this Register and the IHB will be the Register Manager.

Hydro-Related Data Producer Code Register. The Hydro-Related Data Producer Code Register will contain a catalogue of S-57 and S-100 Producer Codes allocated to international organizations, commercial entities or others producing S-57 or S-100 data products that have a requirement to associate a producer code with their data. This function is currently provided on the Open ECDIS Forum (OEF) www.openecdis.org . It is expected that this OEF-based Register will migrate to the Hydro-Related Data Producer Code Register during 2008 with the same ownership and management arrangements as exist on the OEF.

Product Specifications Register

A Product Specification is a description of all the features, feature attributes and relationships of a given application and their mapping to a dataset. A Product Specification provides a complete description of all the elements required to define a particular geographic data product.

Reference to Multiple Registers in a Product Specification. The guidance in S-100 covering Product Specifications has purposely been aligned to ISO 19131. This means that while a prospective user of hydrographic or hydrographically related data can compile a tailored Product Specification using any combination of S-100 features and feature attributes, these can also be combined with other geospatial features and feature attributes from any other Registers compiled under the ISO19100 series of geospatial data standards.

Registering Product Specifications. The IHO Geospatial Information Registry will contain a Register of S-100-based Product Specifications. All IHO Product Specifications will be maintained in this Register together with links to the Product Specifications of other Hydrographically-Related Product Specifications. Additional links to other Product Specifications with less hydrographic relevance may be listed also, such as those covering the oceanographic, environmental and scientific domains.

Numbering of IHO Product Specifications. IHO Product Specifications will form a series starting with S-101 for the next-generation ENC Product Specification. The end of the series allocation would be S-149.

Numbering of Hydrographically-Related Product Specifications. A series S-151 to S-199 may be made available for Hydrographically-Related Product Specifications. This has yet to be decided and will depend upon whether using a similar numbering series to official hydrographic product specifications would be misleading or infer a level of IHO control that should not exist.

Allocation of Registers

The criteria for determining both the allocation of Register Owners and the authorization of Product Specifications are proposed to be as follows:

IHO Registers and Product Specifications include S-100 features and feature attributes required directly or indirectly to support official hydrographic products and services required to meet SOLAS carriage requirements as provided by national hydrographic authorities under the guidelines and specifications of the IHO. These Registers and Product Specifications will normally be hosted by the IHO in the S-100 Registry and maintained by a relevant IHO body. The Product specifications to be authorised by the IHO, would then use the numbering series S-101 to S-149.

Examples: ENC, Official Nautical Publications, Source bathymetry

Hydro-Related Registries and Product Specifications include S-100 features and feature attributes that complement marine navigation and support the activities of national hydrographic authorities but are not required to meet the SOLAS obligations of national hydrographic authorities. These Registers may be hosted by the IHO in the Geospatial Information Registry but will be maintained by the relevant non-IHO competent authority. Any Product specifications will be authorised by the relevant non-IHO competent authority and, subject to further consideration, might then use the numbering series S-151 to S-199.

Examples: InlandENC, Dynamic Ice Coverage, Marine weather/climate, Additional Military Layers, Vessel traffic information

Other Registers and Product Specifications not included in the IHO Geospatial Information Registry include S-100 features and feature attributes with marginal or no relationships with the primary marine navigation roles of national hydrographic authorities. Any Registers and Product Specifications for these would normally be organised, authorised and maintained by the appropriate non-IHO competent authorities under their own Registry arrangements; for example, in other ISO19100 Registries. The numbering convention for Product Specifications ought to be distinguishable from the S-1xx series.

Examples: Maritime Spatial Data Infrastructure (MSDI), Oil and Gas Industry applications, Coastal Zone/Littoral Management.

GII Management and Administration

The management and administration of the IHO Geospatial Information Registry will be conducted through a hierarchy of Owners, Managers and Submitting Organisations.

Registry Owner. A Registry Owner is the organization responsible for a Registry. It is the authority that decides if Registers can be established in its Registry and what policies will apply. The Registry Owner of the IHO Geospatial Information Registry is the IHO. The IHO is also the Owner of the component Feature Data Dictionary Registry, Portrayal Registry, Metadata Registry and Agency Code Registry.

Registry Control Board (RCB). The responsibilities and obligations of the IHO as Registry Owner will be undertaken by a Registry Control Board. The IHO Hydrographic Services and Standards Committee (HSSC) would fulfil this role once it takes over from the Committee on Hydrographic Requirements for Information Systems (CHRIS) in January 2009, under an IHO reorganisation.

Principle roles of the RCB will be to:

- Ensure the effective functioning of the IHO Geospatial Information Registry.

- Control the management of resources required for the establishment and maintenance of IHO Registers.

- Approve the setting up or reorganisation of IHO Registries.

- Consider and decide upon proposals from subordinate management bodies of the Geospatial Information Registry.

- Nominate an appropriate Register for proposals when this has not been resolved by a Registry Manager in consultation with other relevant Register Managers.

Registry Manager. A Registry Manager will be appointed and be responsible for monitoring and maintaining the day-to-day operation of the IHO Geospatial Information Registry. This includes:

- Provide Registry access for Register Managers, Control Bodies, and Register Users;

- Ensure that information about items in the Registers is readily available to users with regard to those items that are valid, superseded, or retired;

- Receive proposals for input to the various Registers in the Registry and forwarding them to all Register Managers; and

- Nominate an appropriate Register for proposals for input in consultation with the relevant Register Managers.

The Registry Manager function for the IHO Geospatial Information Registry and its component Feature Data Dictionary Registry, Portrayal Registry, Metadata Registry and Agency Code Registry will be fulfilled by staff from the International Hydrographic Bureau.

Register Owner. Each established Register has a Register Owner. A Register Owner may be an organization that:

- Establishes one or more Registers.

- Has primary responsibility for the management, dissemination, and intellectual content of its Registers.

- May appoint another organization to serve as the Register Manager.

- Shall establish a procedure to process proposals and appeals made by Submitting Organizations.

In the IHO, a number of existing technical Working Groups (WG) will be Register Owners. For example, the Transfer Standards and Maintenance Development WG (TSMAD) are effectively the Register Owners of the IHO Feature Data Directory Register. The Inland ECDIS Harmonization Group (IEHG) are owners of the Inland ENC Register that is presently maintained on the Open ECDIS Forum. This may be transferred to the GII in the future.

Register Manager. Register Owners will appoint a Register Manager for their Registers. A Register Manager is responsible for the administration of a Register. This includes:

- coordinating with other Register Managers, Submitting Organizations, the related Control Body, Register Owner and the Registry Manager to ensure entries are being compiled in the appropriate Register

- maintaining items within the Register

- maintaining and publishing a list of Submitting Organizations

- distributing an information package containing a description of the Register and how to submit proposals

- providing periodic reports to the Register Owner and/or the Control Body. Each report will describe the proposals received and the decisions taken since the last report. The interval between those reports would normally not exceed 12 months

A Register Manager may manage multiple Registers.

Control Body. A Control Body is a group of technical experts appointed by a Register Owner to decide on the acceptability of proposals for changes to the content of a Register. The Control Body must comprise of experts in the related field that makes up the contents of the Register that they control.

A key element in the management and maintenance of a coherent Registry is coordination between the Register Managers to ensure that there is consistency between Registers. A particularly important coordination function will be in deciding whether new proposals for input to a Register are appropriate or relevant. For most cases this will be obvious and an initial determination by the Registry Manager, in the capacity of overall Registry management coordinator, will be correct. However, where there is doubt, the Register Control Body or Board appointed by the Register Owner should provide direction to the Register Manager. The Control Body should also advise on the acceptability of proposals for changes and additions to the content of a Register.

In cases where a suitable Register cannot be identified through consultation between Register Managers, it may ultimately require a decision from the Registry Control Board.

Submission of Proposals

Submissions and proposals to be included in any part of the Registry will normally come from recognised competent organisations that are qualified under criteria determined by the relevant Register owner to propose changes to the existing content of a Register. The Register Manager will normally determine whether a Submitting Organization is qualified in accordance with the criteria established by the Register Owner.

Register Managers will consider whether a proposed item is suitable for the Register in which it is proposed to reside. The Control Body for that Register is the approving authority. If inclusion in a Register is not approved, the proposer will be informed. Disputed decisions may then be forwarded to the Registry Board by the Registry Manager for resolution.

It is open to a Submitting Organization to develop submissions of proposals for registration according to their respective communities or organizations. However, proposed changes to an IHO Register must then meet the submission procedures established by the Register Owner. These are included in the S-100 documentation.

Author Biographies

Captain Robert Ward has served both afloat and ashore in various appointments associated with nautical chart making and surveying. He is one of three Directors of the International Hydrographic Bureau. His principal responsibility is the oversight of the technical program of the International Hydrographic Organization. He was Deputy Hydrographer of Australia prior to his election to the IHB.

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Barrie Greenslade is the ENC Technical Manager at the UK Hydrographic Office. He is the Chairman of the IHO Transfer Standards Maintenance and Applications Development (TSMAD) Working Group, which, amongst otherds things is responsible for the maintenance of S-57 and the development of S-100 and S-101.

Anthony Pharaoh was appointed to the International Hydrographic Bureau as Professional Assistant for Data Management in 1998 and has been involved in the development of the S-100 standard since its inception. Prior to that, he was employed by the South African Hydrographic Office as head of the Data Management Section.