Note

IHO S-100: The New IHO 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 Hydrographic Geospatial Standard for Marine Data and Information to be known as S-100, together with its supporting geospatial information infrastructure (GII) that is under development and implementation by the IHO. In both cases, details are still being refined. For example, the first draft of S-100 was released for stakeholder comment in March 2008, and S-100 is not expected to be an active standard until 2010. Nevertheless, the concepts and supporting organisational framework behind the GII have already begun to take shape.

The purpose of this paper is to expand upon earlier descriptions, and to draw

attention to what is happening, thereby promoting comment and the active involvement of both existing and potential stakeholders in the development and implementation of both S-100 and the IHO GII.

Brief History of S-57

IHO Special Publication 57 (IHO S-57) is the current IHO Transfer Standard for Digital Hydrographic Data. It was formally adopted as an official IHO standard at the 14th International Hydrographic Conference in May 1992. S-57 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 its 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 Catalogue 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 edition 3.1 is "frozen". It will remain valid until no longer required.

A supplement to S-57 (Edition 3.1.1) was issued in January 2007 to include new features and attributes required to enable the encoding of Archipelagic Sea Lanes (ASL, and Particularly Sensitive Sea Areas (PSSA). These newly designated sea areas were requested by the International Maritime Organization for use by mariners when navigating in certain areas. The inclusion of supplement 3.1.1 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 intended solely for the use of those data producers that need to chart the newly designated sea areas.

Current Limitations of S-57 Edition 3.1

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

- It has an inflexible maintenance regime. Any addition of new features and attributes to the solitary catalogue for new products would have serious consequences for the ENC product specification. It would trigger continual new editions because it prohibits features and attributes which are not required in the ENC. 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) first considered a major revision of S-57 in November 2000 at its 12th meeting. The result is the draft standard S-100 which includes both additional content and a new data exchange format.

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, a specific implementation of S-57 for the purpose of producing an ENC for use in ECDIS. This misconception resulted in a conclusion by many within the ECDIS and ENC community that the work on a new S-57 Edition 4.0 standard would radically change the current ENC, thus affecting existing ENC production and ECDIS implementation. This is not the intention.

In order to avoid a direct connection between S-57 edition 3.1 ENCs and any subsequent IHO data transfer standard, the IHO decided in 2005 that the development of an Edition 4.0 of S-57 would henceforth be designated as S-100: *IHO Hydrographic Geospatial Standard for Marine Data and Information*. Any product specifications developed using S-100 would then follow in an S-10*x* series. Under this schema, when a next-generation ENC Product Specification based on S-100 was developed at some future date, it would be logically designated S-101.

Goals and Objectives for S-100

S-100 is intended to support a wide variety of hydrographic-related digital data sources, products, and customers (see Figure 1). This

includes, but is not limited to, 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 and the hitherto almost exclusive domain of hydrographic offices. Examples of the potential expanded scope of S-100 include Marine Spatial Data Infrastructure, Marine Information Overlays, resource exploration etc.. For this to be achieved, the relevant data domain experts are invited to contribute to the development of S-100 to meet their requirements. How this will be achieved is explained later in the paper.

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 or portrayal. For example nautical publications encoded in XML could be portrayed in PDF, XHTML, ECDIS or plain text. ENC data could be transferred using the traditional ISO/IEC 8211 format or encoded in GML for use in Web Feature/Mapping Services.

- 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, Additional

Military Layers (AMLs) and Marine Information Overlays (MIOs).

Benefits

S-100 should result in a number of benefits:

- 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 greater use and lower costs in implementing S-100 not only for hydrographic information but for all types of marine data in both hydrographic and other applications 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.

- There will be greater compatibility with web-based services for acquiring, processing, analysing, accessing, and presenting data.

- 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.

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 26 liaison organizations including:

- Digital Geographic Information Working Group (DGIWG),
- Global Spatial Data Infrastructure (GSDI),
- Open Geospatial Consortium (OGC),
- United Nations Geographic Information Working Group (UNGIWG).

Alignment with ISO/TC211

Given the prominence of ISO standards and their worldwide recognition and use, it makes sense for IHO to follow the ISO/TC211 suite of standards for the compilation and maintenance of 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 (that is - the Object Catalogue) with that of NATO DIGEST (the DGIWG Feature Data Dictionary – formerly called Feature Attribute Coding Catalogue or FACC). Further, the intention was to develop hydrographic standards that were compatible with a standards. This was endorsed at the 12th meeting of the IHO CHRIS in October 2000. Currently members of both organizations attend each other's meetings and have played important roles in the harmonization process.

ISO 19100 Standards

The standards developed by ISO/TC211 are contained in the ISO 19100 series of geographic information standards. For all forms of broad range of other ISO geospatial 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.

As of January 2009), there are approximately 40 standards in the ISO 19100 series together with another 25 supplementary or additional standards under development. These include draft standards for spatial and temporal schema, metadata, imagery and gridded data, profiles, portrayal, encoding, and so forth. A number of these standards are referenced by S-100 and will be used in conjunction with S-100 based products and applications. The relationship between S-100 work packages and the associated ISO 19100 series of standards is shown in Figure 2.
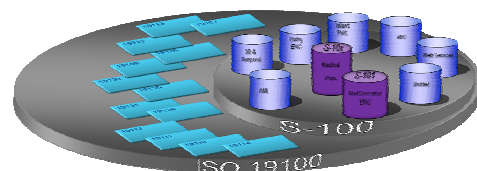

Figure 2: IHO S-100 Components and their associated ISO 19100 series of standards.

S-100 Framework

S-100 comprises multiple components that are 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 than has been the case before.

Alignment with the ISO 19100 series of geographic standards requires that S-100 is organized and defined in a different way when compared to S-57. More specifically, it requires a

new framework or structure, and a revised set of terms to describe the components of S-100. The remainder of this paper describes how this will be achieved.

New Terminology (IHO S-57 →IHO S-100)

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

Some examples of changes in terminology include:

IHO S-100	S-57
registry register	no terms used [*The closest thing to a registry/registers that exists in S-57 is the object/attribute registration arrangement 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*]
feature	*Object*
feature attribute	*Attribute*
enumerated values	*attribute values*
feature concept dictionary	*object catalogue*
curve	*Edge*
point	*Node*
surface	*Face*
application schema	*application profile*

The Registry and Registers

One of the most significant aspects in terms of alignment with the ISO TC/211 19100 series of standards is the employment of a *registry* containing a hierarchy 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, the IHO is hosting an on-line registry engine[2] for S-100 that provides the facility to store various registers of hydrographic-related information.

The S-100 geospatial information register will contain the following principal subordinate registers:

- Feature Concept Dictionary (FCD) registers
- Portrayal registers
- Metadata registers
- Data Producer Code register
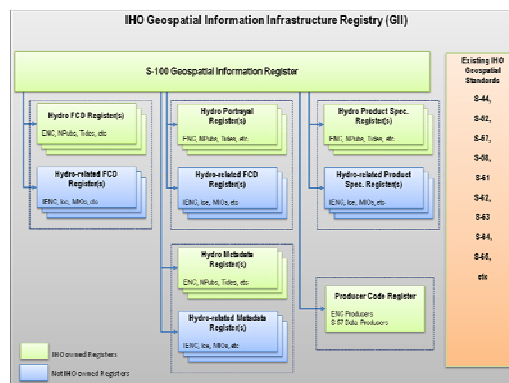- Product Specifications registers

Figure 3 : IHO Geospatial Information Infrastructure Registry

For administrative convenience, in addition to supporting the S-100 geospatial information register and its subordinate registers, the IHO GII registry also encompasses the existing non S-100 based suite of IHO standards and specifications. Most of these standards and specifications will not depend upon the S-100 registers in the short to medium term.

New Possibilities with S-100

The S-100 geospatial information registers will support a number of features not available with the S-57 standard, including:

Unbound Feature Concept Dictionaries. Unlike S-57 feature catalogues, feature concept 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. For each register there will be a group or organization (not necessarily within the IHO) that will be responsible for content and management.
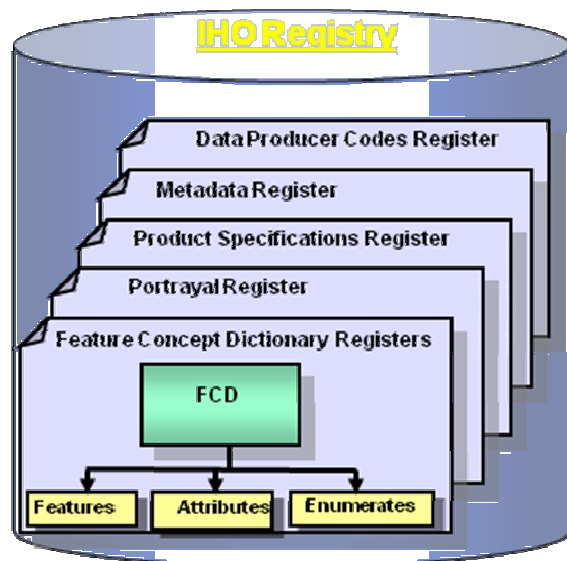
Figure 4: Features, Attributes and Enumerates not bound in the S-100 Registers

Feature Catalogues. S-100 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*.

Flexible Version Control. A major benefit of the register concept is its flexibility. Multiple versions of similar entries in a data dictionary can be maintained using unique identification and classification. An entry is 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 reference items that will always be legitimate 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, newer versions of the existing product specifications will not be required. *Non valid* items are listed in the registers specifically to help identify the inappropriate reintroduction of previously rejected proposals.

Metadata. 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 need to record quality information about their data. This will be at least one part of the 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.

Spatial Geometry. 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 Data. 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.

Multiple Encoding. S-100 itself will not mandate particular encoding formats. This means that the developers of product specifications can decide on the most suitable encoding standard for their particular application.

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.

Standardised Product Specifications. 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 will ensure that any data product specification will maintain a consistent 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

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

The maintenance regime is considerably different in comparison to 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.

S-100 Management and Governance Framework

The S-100 geospatial information register is being structured and managed as prescribed by the S-100 registry component which in turn is a profile of ISO 19135. The S-100 geospatial information register comprises a hierarchical sub-register structure (see also Figure 3) as follows:

- IHO S-100 geospatial information register
- Feature concept dictionary (FCD) registers
- Portrayal registers
- Metadata registers
- Data producer code registers
- Product specifications registers

These registers operate through a web-enabled registry engine and database that houses component registers under each registry. The S-100 register interface is currently located at: http://195.217.61.120/iho_registry/

Ownership

The first use of the S-100 geospatial information register was in 2007 when the IHO Standardisation of Nautical Publications Working Group, the Inland ENC Harmonization Group, and the International Technical Group for Sea Ice (ITSI) began populating registers with relevant information in support of digital nautical publications, Inland ENCs and sea ice reporting respectively.

The criteria for determining both the allocation of register owners and the authorization of product specifications is as follows.

IHO Registers and Product Specifications relate to S-100 features and feature attributes, portrayal, et cetera that directly support the purposes of the IHO, such as those required to meet the chart and nautical publications carriage requirements of the UN Convention on the Safety of Life at Sea (SOLAS). These registers and product specifications will be hosted by the IHO in the over-arching S-100 geospatial information register and maintained by the relevant IHO body. The derived product specifications, to be authorised by the IHO, will use the numbering series S-1*xx*.

Examples: ENC, official nautical publications, source bathymetry

Hydro-Related Registries and Product Specifications relate to S-100 features and feature attributes that complement the purposes of the IHO, or that support the activities of its Member States. These registers will be hosted by the IHO in the over-arching S-100 geospatial information register subject to approval by the IHO, but will be maintained by the relevant competent authority. In most cases this will not be an IHO body. Any product specifications will be authorised by the relevant competent authority appropriate to the register owner. The numbering convention for these product specifications must be intuitively distinguishable from the S-1*xx* series because they will not normally be IHO standards or specifications.

Examples: Inland ENC, Sea Ice Coverage, Additional Military Layers (AMLs), Marine Information Overlays (MIOs), marine weather/climate

Other Registers and Product Specifications not included under the S-100 geospatial information register include S-100 features and feature attributes with marginal or no relationships with the primary charting 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 these product specifications should be clearly distinguishable from the S-1*xx* series so as to avoid any direct association with IHO.

Examples: Maritime Spatial Data Infrastructures (MSDI), General Bathymetric Chart of the Ocean (GEBCO), UN Law of the Sea (UNCLOS), Oil and Gas Industry applications, Coastal Zone/Littoral Management, Oceanographic Data.

Feature Concept Dictionary Registers

The *feature concept dictionary* (FCD) registers contain items that specify sets of definitions for *features*, *feature attributes*, and *enumerated values* that may be used to describe geographic information. The feature concept 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. Maintenance of these catalogues and product specifications will not be dependent on the maintenance of the S-100 base standard or feature concept dictionaries, as is presently the case for S-57.

Portrayal Registers

Similar to the FCD registers, the *portrayal registers* comprise a number of registers containing collections of related symbols and portrayal rules. 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 Registers

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 registers will also include registers of metadata definitions.

Data Producer Code Register

The *data producer code* 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

register will also contain a catalogue of S-57 and S-100 producer codes allocated by the IHO 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. The OEF-based register will migrate to the S-100 data producer code register during 2009.

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. The product specification register will contain meta information relating to product specifications e.g. S-10x number, title, scope, contact details, location, and so on.

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 S-100 geospatial information register will contain a register of S-100-based product specifications. All IHO S-100 based 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 S1*xx* starting with S-101 for the next-generation ENC product specification.

Numbering of Hydrographically-Related Product Specifications. The numbering convention for the so-called hydrographically-related product specifications must be intuitively distinguishable from the S-1*xx* series because they will not normally be IHO standards or specifications. How this will be achieved has yet to be decided and will depend upon whether using a numbering series similar to official hydrographic product specifications would be misleading or infer a level of IHO control or responsibility that does not exist.

Benefits of the Registry Concept

The establishment of the IHO GII registry will provide more flexibility in the management of the key product elements that 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 will all be processed and implemented much quicker in S-100 than previously under S-57.

Because no registered item is ever removed from the S-100 registers, items will always exist in one of four states: *valid*, *invalid*, *superseded* or *retired*. This means that there will be no requirement for immediate consequential changes or upgrades to existing Product Specifications because items referenced in registers remain legitimate even if a new version is registered. 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 its derived ENC product Specification have been, in effect, frozen for some time.

GII Management and Administration

Management and administration of the IHO GII registry is achieved through a hierarchy of *Owners*, *Control Bodies*, *Managers* and *Submitting Organisations*.

Register Owner. A *register owner* is the organization responsible for a register. It is the authority that decides if subordinate registers can be established under its register and what policies will apply. The register owner of the IHO S-100 geospatial information register is the IHO.

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 its register manager.
- shall establish a procedure to process proposals and appeals made by submitting organizations.

In the IHO, a number of technical working groups (WG) are already register owners. For example, the Transfer Standards and Maintenance Development WG (TSMAD) are the owners of the IHO Feature Concept Directory register. The Inland ENC Harmonization Group (IEHG) is owner of the Inland ENC register. The International Ice Charting Working Group (IICWG) of the World Meteorological Organization (WMO) is the owner of the Sea Ice Register.

Figure 5 illustrates how the FCD domain in the S-100 geospatial information register is being subdivided between IHO and non-IHO owners. Similar arrangements apply to the other register domains.
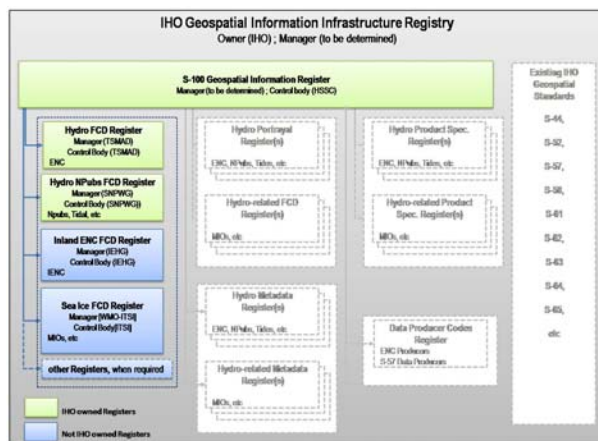

Figure 5 : Example of the Allocation of register Owners in the GII

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 its 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 is to decide 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 register manager, in the capacity of overall register management coordinator, will be correct. However, where there is doubt, the register control body 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.

An example of an existing control board is the sub-group of the Transfer Standards and Maintenance Development WG (TSMAD) who adjudicate on proposals for the IHO Feature Concept Directory register; another is the Inland ENC Harmonization Group (IEHG) that relies on the IEHG Core Group to moderate the activities of their Inland ENC registers.

In cases where a suitable register cannot be identified through consultation between register managers, it may ultimately require a decision from the overarching S-100 register control body which is the IHO Hydrographic Services and Standards Committee (HSSC).

Register Manager. Register owners 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 S-100 geospatial information register manager to ensure entries are being compiled in the appropriate register,

- maintaining items within their register,

- maintaining and publishing a list of submitting organizations,

- distributing an information package containing a description of their register and how to submit proposals,

- providing annual reports via the S-100 geospatial information register manager to the S-100 geospatial information control body (IHO Hydrographic Service and Standards Committee (HSSC)). Each report will describe the proposals received

and the decisions taken since the last report.

A register manager may manage multiple registers.

Submitting Organizations. Submitting organiza-tions submit proposals for registration according to their respective communities or organizations needs. Proposed changes to the contents of a register follow the submission procedures established by the register owner.

Proposals for New Registers. Submissions and proposals to create new registers will normally come from recognised competent organisations that are qualified under criteria determined by the relevant superior register owner. The register manager will normally determine whether a submitting organization is qualified in accordance with the criteria established by the register owner.

Proposals for New S-100 Components. Register managers 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. Appeals against decisions may then be forwarded to the IHO geospatial information control body (the HSSC) by the IHO geospatial information register manager for resolution.

IHO Geospatial Information Infrastructure Registry

Registry Owner- The IHO is the owner of the IHO GII Registry.

Registry Manager - The IHO GII Registry Manager function will be performed by staff from the International Hydrographic Bureau. Currently (January 2009) this function, as it applies to S-100, is being undertaken by the Chairman of the IHO Transfer Standards Maintenance and Applications Development (TSMAD) Working Group, with the support of the UK Hydrographic Office.

The Registry Manager's duties include:

- Routine maintenance of the registry system and infrastructure.
- Management of the interface and databases including the provision for adding new registers.
- Maintaining the system security and data backup functionality.

IHO S-100 Geospatial Information Register

Register Control Body - The IHO Hydrographic Services and Standards Committee (HSSC) undertake the responsibilities and obligations of the register control body for the IHO S-100 geospatial information register.

Principle roles are: to:

- Ensure the effective functioning of the IHO S-100 geospatial information register.

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

- Adjudicate unresolved appeals submitting organizations whose proposals are deemed unacceptable by individual register control bodies.

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

- Approve the setting up or reorganisation of IHO registers.

- Process and approve applications for the setting up new registers from non-hydrographic organizations.

Register Manager - The S-100 geospatial information register manager will be responsible for monitoring and maintaining the day-to-day operation of the S-100 geospatial information register. This includes:

- Providing registry access for subordinate register managers, control bodies, and register users.

- Ensuring that information about items in the registers is readily available to users with regard to those items that are valid, superseded, or retired.

- Receiving proposals for input to the various registers in the registry and forwarding them to all register managers.

- Nominating an appropriate register for the input of proposals in consultation with the relevant register managers.

The S-100 geospatial information register manager function should be fulfilled by staff from the International Hydrographic Bureau. Currently (January 2009) this function is being undertaken by the Chairman of the IHO Transfer Standards Maintenance and Applications Development (TSMAD) Working Group, with the support of the UK Hydrographic Office.

Migrating from S-57 Edition 34.1 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 IHO S-57 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.

The development, implementation and transition into force of S-101 will follow the IHO governance model for technical standards as illustrated in Figure 6. Figure 6 also shows the current (January 2009) development of S-100 and S-101.

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. As a consequence of the extensive development process, 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. 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.
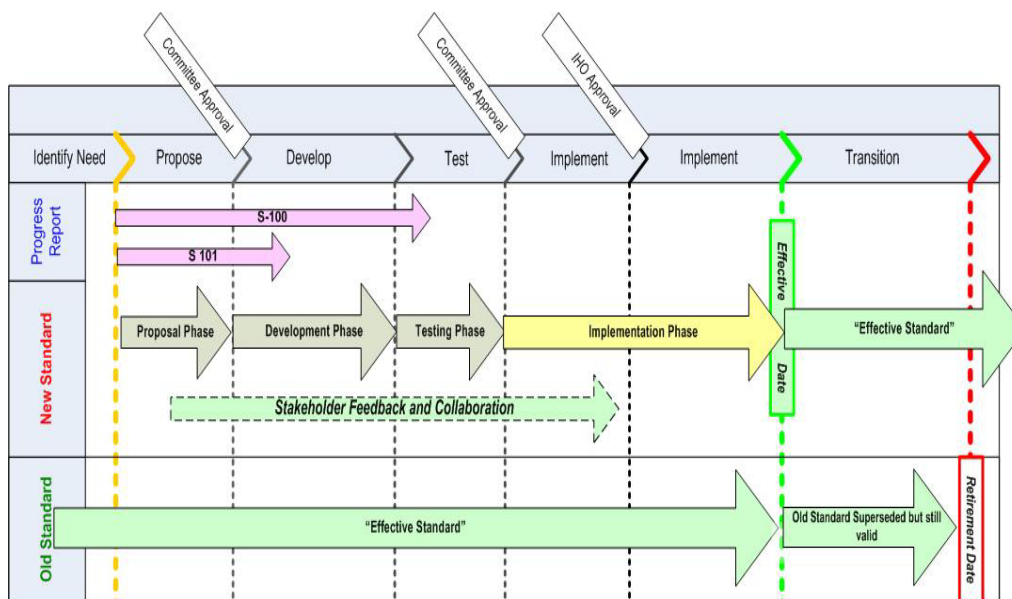

Figure 6: Lifecycle of an IHO Standard