INTERNATIONAL HYDROGRAPHIC ORGANIZATION

ORGANISATION HYDROGRAPHIQUE INTERNATIONALE

HYDROGRAPHIC SERVICES AND STANDARDS COMMITTEE
COMITE DES SERVICES ET DES NORMES HYDROGRAPHIQUES

MASTER PLAN FOR THE DEVELOPMENT AND IMPLEMENTATION OF S-100

(Edition 1.1.0 - June 2015)

Content

1 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. Digital hydrographic information has become a basic element of all aspects of use and preservation of the maritime domain. Consequently, a huge variety of stakeholders beyond the community of national hydrographic services is supportive to IHO´s objectives in standardization of hydrographic data: greatest uniformity and interoperability.

This plan describes the development and implementation phases of IHO´s core standardization project over the next five years: The Universal Hydrographic Data Model designated S-100. The S-100 Model was basically designed as the succeeding standard to current IHO Transfer Standard for Digital Hydrographic Data S-57. But S-100 supports a much wider variety of hydrographic-related digital data sources, products, and customers. This includes new geospatial models to support imagery and gridded data, 3-D and time-varying data, and new applications that go beyond the scope of traditional hydrography - for example, high-density bathymetry, seafloor classification, marine GIS, etc..

Due to S-100 wide range of applicability and its strict compliance with the geoinformation standards of the International Organization for Standardization (ISO 19xxx series), the International Maritime Organization (IMO) agreed that S-100 is an appropriate baseline standard for creating a framework for e-Navigation data access and services called the “Common Maritime Data Structure” (CMDS). The Geospatial Information (GI) Registry constitutes the foundation of the S-100 Model. Like a digital library, the Registry hosts data model entities to design and maintain interoperable data product specifications of nearly unlimited purpose. The Registry also provides dynamic features and portrayal catalogues, which will enable the harmonization, updating and delivery of data products. Originally intended to cover geospatial data only, it appears that the S-100 concept could be enhanced to all aspects of shipping and the maritime domain at large, including the modelling of non-spatial information e.g. pilot requests, regulatory information and user requirements.

The purpose of this master plan is to determine the long term goals and objectives of the development and implementation of S-100 and related specifications and tools, and to outline the tasks that need to be considered to achieve these objectives and the associated timelines. It expands upon earlier descriptions of the development of S-100, to explain the rationale of what is happening and promote the active involvement of both existing and potential stakeholders. Special emphasis is put on the development and implementation of the product specification S-101 - the standard for the next generation ENC.

- Section 2 provides an overview of the S-100 based architecture and governance.
- Section 3 addresses use and maintenance of the S-100 Registry.
- Section 4 discusses existing and planned data product specifications based on the S-100 Registry in general, whereas
- Section 5 presents the specific roadmap for the development and implementation of S-101 ENCs,
- Section 6 outlines the establishment of the S-100 Test Bed,
- Section 7 outlines the process for developing and implementing S-100 based product specifications for IHO and non-IHO products and services, and
- Section 8, finally elaborates the impacts on and interactions with the various stakeholders as anticipated so far.

2 Principles of S-100

S-100 provides a contemporary hydrographic geospatial data standard that can support the variety of hydrographic-related digital data sources, products, and customers. Its main features 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 product specifications will be a subset of S-100, including separate feature catalogues. This allows the core standard to evolve (through extension) without the need to introduce new versions of product specifications.
- Alignment with the series of current geospatial information standards adopted by the International Organization for Standardization (ISO 191xx). This ensures compatibility, or interoperability, with other domains.
- An ISO-conforming web-based registry containing registers for feature data dictionaries, portrayal and metadata. The registers accommodate both core hydrographic content and other chart related content and can be extended beyond geospatial data. The registry architecture also contributes to the flexibility of the standard.

S-100 specifies, for hydrographic and related information, methods and tools for data management, processing, analysing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations. By following this set of standards users will be able to build constituent parts of an S-100 compliant product specification.

The employment of the notions of registry and registers is one of the most significant aspects in terms of alignment of S-100 with the ISO series of standards. A registry is the entire information system (or location) in which a collection of registers is located. A register is a collection of tables in a database containing identifiers assigned to items with descriptions of the associated items. Descriptions may consist of many types of information, including names, definitions and codes. The S-100 Registry is described in more detail in Section 3 below.

Maintenance of S-100 and the release of new versions is governed by the rules laid out in IHO Resolution 2/2007 as amended - *Principles and Procedures for making changes to IHO Technical Standards and Specifications*. Changes to S-100 are coordinated by the "S-100 Working Group" (S-100WG) of the IHO. Organizations that wish to make changes to S-100, must address their comments to the IHO Secretariat (info@iho.int).

The IHO shall release new versions of S-100 as necessary via the IHO web site. New versions shall include clarifications, corrections and extensions. Each version shall contain a change list that identifies the changes between versions of S-100.

Clarifications are defined as non-substantive changes to S-100. Clarifications remove ambiguity and errors in spelling, punctuation and grammar. A clarification shall not cause any substantive semantic change. Clarifications shall be denoted as 0.0.x. Each clarification or set of clarifications approved at a single point in time shall increment x by 1.

Corrections are defined as substantive semantic changes to S-100 to correct factual errors. A correction shall not be classified as a clarification. One correction may result in multiple related actions. All cumulative clarifications shall be included with the release of approved corrections. Corrections shall be denoted as 0.x.0. Each correction or set of corrections approved at a single point in time shall increment x by 1. Correction version control shall set clarification version control to 0.

Extensions are significant changes to S-100. They can include additional information from the IHO or ISO TC211 geographic information standards that were not originally included in S-100 that may be needed for additional applications. Extensions result in a new major version of S-100. One extension may result in multiple related actions. All cumulative clarifications and corrections shall be included with the release of approved extensions. Extensions shall be denoted as x.0.0. Each extension or set of extensions approved at a single point in time shall

increment x by 1. Extension version control shall set the clarification and correction version control to 0.

3 Tools and Maintenance of S-100 GI Registry

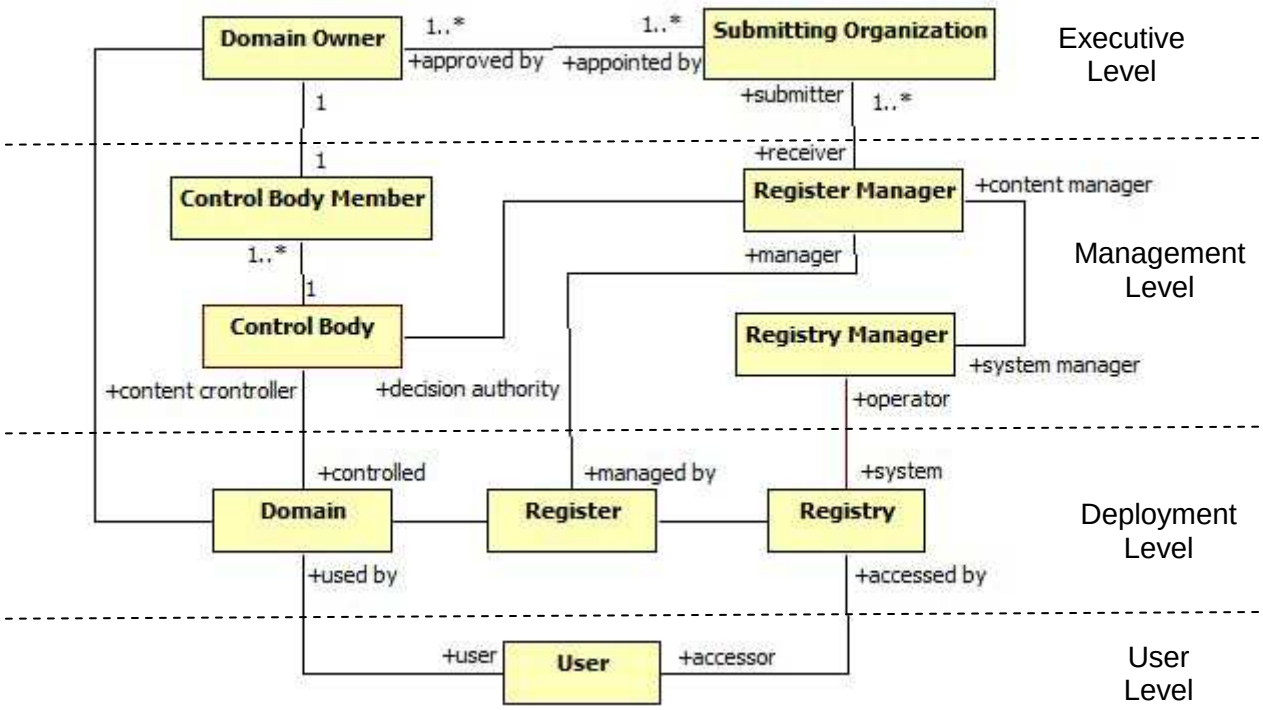

Figure 1 - Functional Diagram of the S-100 GI Registry.

The on-line S-100 Registry under development by the IHO consists of five types of Registers:

- Feature Concept Dictionary Register,
- Portrayal Register,
- Metadata Register,
- Product Specifications Register,
- Data Producer Code Register.

The Feature Concept, Portrayal and Metadata Registers are, in effect, managed lists or dictionaries of items. Selections from these 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; for example, Hydrographic Offices for ENC producer codes.

The Metadata Register has not yet been established and there is no indication at this stage that the amount of items to be registered will warrant its establishment within the timeframe of this plan. The

metadata elements are currently described in Part 4 of S-100. However, this situation may evolve with the development of wider applications of the S-100 framework such as the CMDS.

Within the Feature Concept Dictionary and the Portrayal Registers each entry is assigned to a recognized "domain". The purpose of designating domains is to ensure that the key stakeholders (as represented by the domains) are consulted in any subsequent proposals to adjust items already contained in a Register. The Feature Concept Register has the following domains:

Domain	**Name**	**Owner**
HYDRO	Hydrographic	IHO
NPUBS	Nautical Publications	IHO
ICE	Sea Ice Information	JCOMM
Inland ENC	Inland ENC	Inland ENC Harmonization Group
PENC		Port ENC
Hamburg Port Authority		
AIS	Automatic Identification Systems	IALA
AtoNs	Aids to Navigation	IALA
VTS	Vessel Traffic Services	IALA
WXO	Weather Ocean Forecast	JCOMM

Besides the IHO, three other organizations are currently involved in maintaining domains within the Feature Concept Register:

- the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) for the domains related to Aids-to-Navigations and associated services;
- the Inland ENC Harmonization Group (IEHG) for the Inland ENC domain;
- the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the Intergovernmental Oceanographic Commission (IOC) and the World Meteorological Organization (WMO) for the domains related to marine meteorology and oceanography (including sea ice).

Other maritime data domains will be included over time as new requirements and applications emerge. Any recognized organization can propose a new domain. Each Register Manager may also propose a new domain depending on the needs of a Register, its existing users or an awareness of any potential new users or new requirements.

The Feature Concept Register, the Portrayal Register and the Metadata Register are each overseen by two control bodies, a Domain Control Body (DCB) that assesses and endorses proposals and an Executive Control Body (ECB) that oversees the operation of the Registers and adjudicate any disputes. DCB and ECB oversight is not required for the Product Specification Register nor the Producer Agency Code Register because they are both, in effect, non-discretionary lists of entries requiring little or no decision making or vetting. The Control Bodies are composed of technical experts appointed by the Register Owner; each of the domains recognized in a register is represented in the relevant Control Body.

A Submitting Organization is an organization that is qualified under criteria determined by the Register Owner to propose changes to the content of a register. The Register Manager determines whether a Submitting Organization is qualified in accordance with the criteria established by the Register Owner.

The S-100 GI Registry is owned by the IHO, represented by the President of the Directing Committee of the International Hydrographic Bureau (IHB). The Registry Owner decides whether a proposed register shall be hosted on the registry and establishes the policy for access. The relevant decisions are made in accordance with IHO regulations.

The operational procedures for the use of the S-100 Registry are described in IHO publication S-99 - *Operational Procedures for the Organization and Management of the S-100 Geospatial Information Registry*.

4 S10x data product specifications based on the S-100 Model

An S-100 based 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. S-100 provides the framework to ensure that any data product specification will maintain a consistent structure based on the components shown in Figure 2.

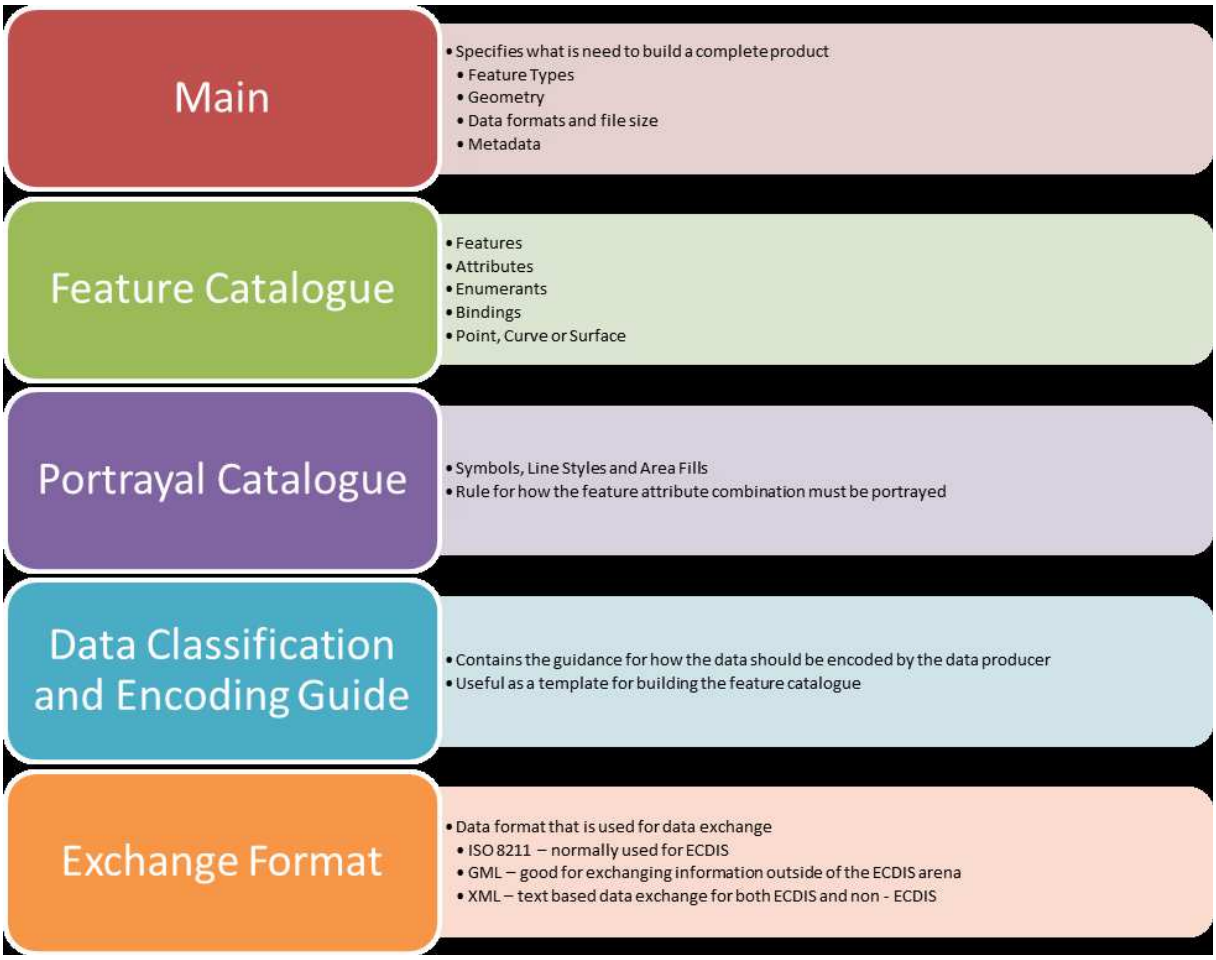

Figure 2 - Structure of an S-100 based data product specification.

The work on S-100 based Product Specifications has focused on geospatial products so far. One IHO Product Specification was released in 2012 (S-102 - *Bathymetric Surface Product Specification*) and other are in various stages of development, such as S-101 - *ENC Product Specification*; S-111 - *Surface Currents*, S-112 - *Real time tidal data transfer*, and S-122 - *Marine Protected Areas*. The IHO maintains a list of S-100 based product specification identifiers on the following webpage: http://www.iho.int/iho_pubs/standard/S-100_Index.htm. The IHO has developed a generic template to guide the development of product specifications for any marine information overlays. This template can be found in S-100 edition 2.0.0 Part 11, Appendix 11-D.

S-100 based Product Specifications being developed with other organizations include:

- S-121- *Product Specification for maritime boundaries data*, developed in liaison with the United Nations Division for Ocean Affairs and the Law of the Sea;
- S-411 - *Product Specification for sea ice*, developed by the Expert Team on Sea Ice of JCOMM;
- S-412 - *Product Specification for met-ocean forecasts*, developed by the Expert Team on Maritime Safety Services of JCOMM.

IALA has developed guidance to preparing S-100 product specifications related to aids-to-navigations (AtoN) and associated services. It has also initiated the preparation of product specifications for AtoN information, maritime safety information and vessel traffic information.

IEHG is following the development of S-101, and intends to align the product specification for Inland ENCs with S-101.

Most of the on-going developments are concentrating on geospatial products and services. However, the ability to use the S-100 framework to model substantially non-geographic maritime information, such as notice of arrival and pilot requests, has already been investigated with success as reported to IALA and IHO.

5 S-101 ENC: Roadmap for development and introduction

An overview of the sequence of activities is listed below. A more detailed description can be obtained in the S-101 Value Added Roadmap. The timescales involved are very much dependent on available resources.

5.1 Time line

Figure 3 provides an estimated time line of events in the development, test and implementation of S-101.

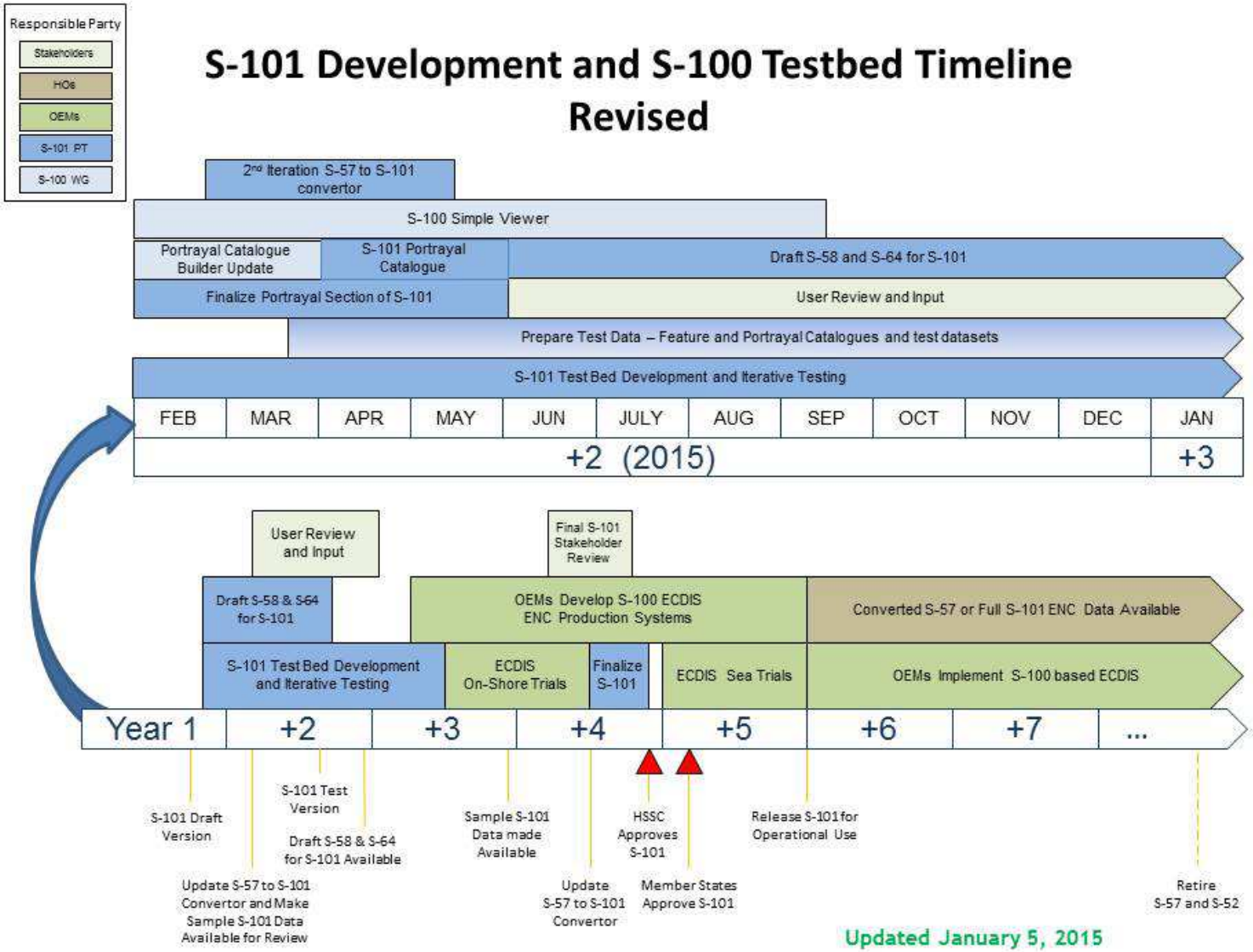

Figure 3 - Projected timescale for the implementation of S-101 as a component of an overarching e-Navigation ECDIS environment.

5.2 Steps in development

5.2.1 S-101 First Draft

The initial draft of S-101 was baselined in June 2015. This initial version will be the basis for an extensive testing programme. There are many new concepts which need to be proved and the draft will undoubtedly evolve throughout this period before a stable version can be published for stakeholder evaluation.

5.2.2 Initial Test Bed

The initial test bed for S-101 will be coordinated by the S-100WG as part of the global S-100 Test Bed (see Section 6). The test strategy will outline the overarching goals of the S-100 test bed, including: test processes, defect management, responsibilities, and form the overarching guidance for the S-101 test bed and iterative test process.

5.2.3 S-58 and S-64

As part of the test bed process there will need to be versions of S-58 - *ENC Validation Checks* and S-64 - *IHO Test Data Sets for ECDIS* developed specifically for S-101. Draft versions will be available by the 2nd quarter of 2016.

5.2.4 OEM Review

Once a relatively stable version of S-101 has been established during the testing phase this will be distributed to the various manufacturers involved in all processes creating, delivering and using the data. Draft S-101 versions of S-58 and S-64 will be made available during this period. Results of this review will be fed back into the main testing process and new iterations of S-101 developed. Also during this period consideration will be given to the development of performance standards and IEC61174.

5.2.5 OEM Implementation

It is intended that once a relatively stable version of S-101 is published ECDIS OEMs, production software and validation tool manufacturers will start to develop their systems in order to contribute to the trials which follow.

This will also be an opportunity for data producers to help test new software and become familiar with the new content and structure of S-101.

5.2.6 ECDIS On Shore Trials

It is anticipated that at least one and possibly more S-100 enabled ECDIS will be available for the trials. All aspects of the process will be tested extensively including - data production, validation and distribution; ECDIS type approval and functionality, extensive user involvement, particularly training establishments. A dual fuel regime will test the capabilities and any issues with distributing both S-57 and S-101 ENC datasets.

5.2.7 S-101 Final Draft

During the second half of 2017/18 (resource dependent) a thorough stakeholder review will culminate in a paper to the HSSC seeking endorsement of version 1.0.0 and a recommendation to seek the approval of IHO Member States to publish.

This version will contain a caveat stating that S-101 is still not available for across the board implementation and will be only used for testing until an announcement is made about a final release date through the IHO Secretariat.

5.2.8 ECDIS Sea Trials

This will be a similar process to the on shore trials, but will emulate a real time environment.

5.2.9 S-101 Released for full implementation

At this point the IHO has certified that S-101 is ready for full implementation by the hydrographic community. This will entail the need for hydrographic offices to begin production of S-101 data in addition to S-57 data. This will mean that the distribution systems are in place and that the OEMs have designed and are selling upgraded ECDIS systems.

6 Establishing the S-100 Test Bed

The development of S-100 and S-101 by the IHO has reached the stage where testing and further development are required to complete the standards and associated elements to deliver a specification that can produce data and be used operationally. As part of the specification development process the S-100WG is in the process of establishing an S-100 Test Bed. The test bed adopts a systems engineering approach (using ISO 15288:2008) reflecting that standards can only be tested based on implementation and that a complex system of systems make up the marine navigational environment.

As part of this approach the S-100WG maintains an S-100 Test Bed framework document. This framework is intended to support the testing of a wide range of S-100 based product specifications. The level of testing required for each product specification will vary depending upon the end use of the data. For example, if the data is intended to be used in an ECDIS to support navigation, then the product specification should utilize component of the framework. If the end result is for shore-based information systems, then it may not be necessary to test the product specification all the way to full ECDIS capabilities.

The framework relies on the following objectives:

- *S-100 products display and function as required by users in S-100 ECDIS. Standards and testing must ensure the required level of consistency and reliability.*
- *S-100 products can be distributed and ingested in a proper and reliable manner by S-100 ECDIS.*
- *S-100 products can be collated and packaged into distribution packages with required data integrity etc..*
- *S-100 products can be validated to conform to defining standards and acceptable quality levels.*
- *S-100 products can be created and updated.*
- *S-100 feature and portrayal catalogues can be created and updated. Processes must ensure catalogues are valid and consistent.*

More specifically, this framework will test four major types of products that could be used within an S-100 ECDIS. They are:

- *S-101 - ENC Product Specification;*
- *S-10X - Overlay – where the data would overlay the base ENC to provide additional information;*
- *S-10X Partial Replacement – where the data would replace part of the base ENC to provide more detailed information*
- *S -10X wholesale replacement – where the data would replace the entire ENC. For example a port ENC may replace the existing harbour ENC.*

In order to manage the number of sub systems and complexity involved this framework will break the overall S-100 system testing into 9 phases. These are shown in Figure 4 and follow a logical progression from catalogue creation through to use within ECDIS.

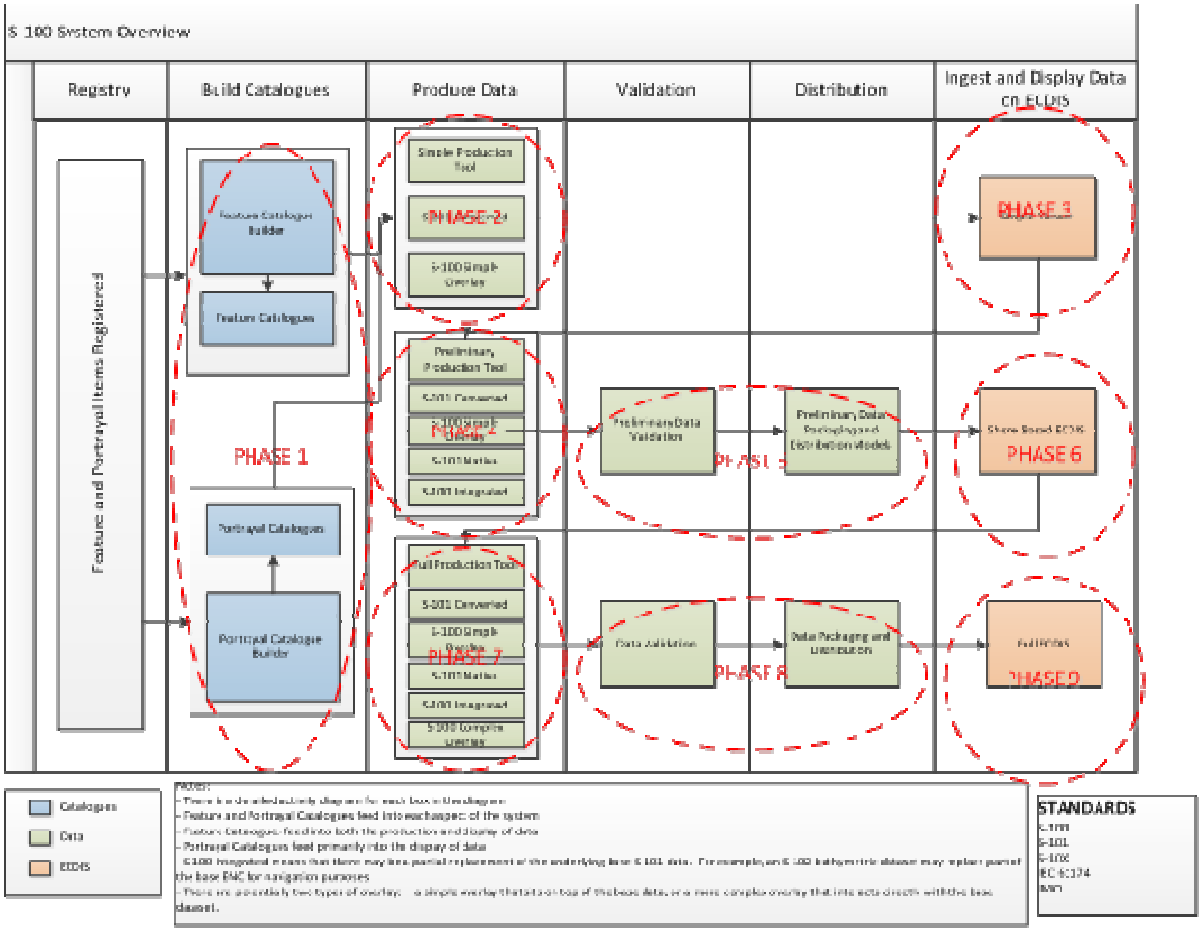

Figure 4 - S-100 High Level System Testing Overview with Phases.

Breaking out the testing through phases allows for the iterative development of future ECDIS as a system by gradually expanding requirements and test bed. At a high level the phases are as follows:

Phase 1: Feature and Portrayal Catalogue Generation. This phase is split into two parts that concentrate on the feature and portrayal catalogue builders and the generation of catalogues to support the S-101 product specification and S-100 based product specifications.

Phase 2: Initial Data Conversion Tool. This phase deals with creating S-101 ENCs by using the S-57 convertor. In addition, it will also look to create an S-100 simple overlay file for use in testing.

Phase 3: Simple Viewer. This phase is split into three parts to create a simple viewer that will ingest feature and portrayal catalogues, along with an S-100 based dataset to validate if the dataset displays according to what is defined in the portrayal catalogue. It is split into three phases in order to build capability to view datasets that are utilizing different S-100 encoding formats.

Phase 4: Preliminary S-100 Based Datasets. This phase deals with multiple datasets and scenarios to provide test data for S-100 testing. At this time, it is expected that test data will not be converted data from S-57, but rather data that can realize the full functionality of S-100.

Phase 5: Preliminary Data Validation and Distribution. This phase will put in place draft data validation rules and test data packaging and distribution models.

Phase 6: Shore-Based ECDIS. This phase deals with the creation and testing of several shore based ECDIS. This version of the S-100 ECDIS is not expected to have the full capabilities of an ECDIS that will undergo type approval, but should be able to handle different types of S-100 based data, perform basic navigation functions – such as set the safety contour and have the pick report functionality implemented.

Phase 7 - 9: Complete S-100 datasets for testing and validation, Data Validation, Distribution, and Full ECDIS. These final three phases deal with the full system testing and implementation of S-100 and S-101.

7 Process for developing and implementing S-100 based product specifications for IHO and non-IHO products and services

S-100WG Work Items F.1 and F.2 enable the working group to liaise with other IHO WGs and external organizations in an advisory capacity.

In order to assist other IHO working groups and external organizations that wish to build S-100 compliant product specifications, the S-100WG has developed a common template for developing product specifications. This template has been adopted as Part 11, Appendix 11-D of S-100 edition 2.0.0.

In addition, In addition, the S-100WG is also developing an S-100 interoperability guidebook. This guidebook will outline how S-101 ENC datasets will be used in conjunction with other S-100 based datasets, such as S-102 (high resolution bathymetry), S-112 (real time tidal data), and S-412 (met-ocean forecasts). This guidebook will include details how each type of product specification is integrated with each other in order to properly display without obscuring navigationally significant information. It is expected that the first draft of this guidebook will be available late 2016.

8 Impact on / interaction with stakeholders

S-100 has been designed as a framework standard and as such will have minimal or no impact until used in the development of products. The following sub-sections will only indicate where those organizations or working groups would be involved in tasks maintaining S-100.

An assumption is also made that any product specification is based on S-100.

8.1 IHO bodies and Member States

8.1.1 Hydrographic Offices

S-100:

Providing WG attendees with the necessary knowledge and experience to maintain S-100.

S-101:

In many respects the changes introduced by S-101 will be transparent to the encoders of ENCs. The largest percentage of features and attributes remain unchanged, but there will be a need to change the techniques used where information types and complex attributes are introduced. As for the new cartographic text feature, it is not inconceivable that new multi-

product database solutions will re-use parameters stored during the text placement process for other products like the nautical paper chart.

In view of the above it is anticipated that although changes will be required to production systems this will not be a wholly disruptive experience.

Understanding that producers will not easily be able to switch immediately to producing S-101 datasets and in order to ensure a relatively painless transition from S-57 to S-101 a converter has been developed which can either be used stand alone or built into the export process. This will provide an S-101 version of the existing S-57 ENC and can be used until full specification S-101 ENCs are produced. S-57 will continue to be supported until phased out at a date to be decided.

Although the converter will solve many issues, there will exist a need for carefully managed distribution streams for both S-57 and S-101 data until all ECDIS are S-100 compliant.

The implementation of S-58 will change with the introduction of S-101. Currently there is not a mechanism to verify that a dataset has been properly validated against the S-58 checks. S-101 datasets will have a certification methodology which will enable ECDIS to verify that data is fit for purpose.

Other IHO Product Specifications:

This would be entirely dependent on the interest a particular HO would have in either assisting with the development of a particular product specification or actually producing the product.

The cost of developing new or extended production systems should be relatively small given the COTS enabling factor of S-100.

Other non-IHO Product Specifications:

This should be a similar scenario to that for IHO Product Specifications.

8.1.2 Regional Hydrographic Commissions (RHCs)

S-101:

S-101 retains its position as the primary product for electronic navigation. RHCs should continue their current role in maintaining consistency and coverage in their area.

S-100:

With the advent of the e-Navigation initiative it is anticipated that many new products specific to the maritime environment will emerge. RHCs should be aware of this and monitor progress.

8.1.3 IHO Secretariat (IHB)

The S-100 Registry is currently maintained through in-kind support provided by a few Member States. To ensure reliability and an appropriate level of support to users, the maintenance and day to day management of the S-100 Registry requires a dedicated registry manager. As agreed by the 5th Extraordinary International Hydrographic Conference, the recruitment of an IHB staff member to undertake the duties of S-100 Registry Manager should be given priority as soon as an opportunity occurs.

8.1.4 WEND implementation (including RENCs)

S-101:

There should be no change top the current WEND principles other than a RENC's need to manage both S-57 and S-101 data distribution until S-57 is retired.

8.1.5 Technical capacities / technical cooperation

S-100:

S-100 is governed by Resolution 2/2007, all committees and WGs must follow the processes therein.

Currently the S-100WG is responsible for S-100, with contributions from DQWG (quality). The S-100WG liaises with other WGs and organizations in advising on the use of and maintenance of S-100.

Other WGs both IHO and non-IHO who develop S-100 based products will normally feed request for change through the S-100WG. In exceptional cases which may involve major extension to S-100 proposals would need HSSC approval if it impacted the HSSC Work Programme.

8.2 Partner Organizations

8.2.1 Liaison with IMO

(see document HSSC5-01D)

8.2.2 Liaison with ISO

8.2.3 Liaison with IALA

8.2.4 Liaison with IEC

8.2.5 Liaison with IEHG

8.3 Other Submitting Organizations

(discuss the impact on organizations not listed in 8.2 which may wish to contribute to the development of the S-100 registers)

Any established organization in maritime environment may apply to become a Submitting Organization to the Registry.

8.4 OEMs

8.4.1 Type approval

One of the products that will be available as part of the release of S-101 will be a version of S-64 that will be extended to include tests for the mechanisms needed for the updating of feature and portrayal catalogues and any other new information that is contained within in S-101. The biggest change that is anticipated is that there will be a significant reduction in the need to re-type approved systems. The various catalogues can be treated as data much the same as an ENC or other product. The OEMs will only have to prove the process of importing the catalogues.

8.4.2 Downward compatibility

S-100 based ECDIS will need to be fundamentally different from their S-57 counterpart. Although there need not be any major changes made to the human interface, the underlying kernel will require significant reworking in order to take advantage of the "plug and play" planned developments.

The ISO/IEC 8211 format has been retained, but has been updated to align with the S-100 model.

The kernel will need to be capable of importing the various machine readable catalogues - feature, portrayal, alerts and indications, and producer agency codes.

8.5 Service Providers

8.5.1 Commissioning of data packages including feature and portrayal catalogues

One of the main issues during the transition from S-57 to S-101 ENCs will be the need for a delivery process for both types of data sets. In a similar way, the various catalogues for updating ECDIS are data sets which will require a distribution method. Currently there is on-going discussion whether this will be undertaken centrally, via web-based download, through OEMs or service providers etc.

The provision of a more robust and better structured version of S-58 will increase the efficiency of the process and provide better quality control.

8.5.2 Encryption and Digital Signatures

S-63 version 2.0 will be introduced with the implementation of S-101. Elements from S-63 like encryption and digital signatures have been included in S-100 edition 2.0 and this will then filter down to S-101 and other S-100 based product specifications.

8.5.3 SENC distribution

The modified version of ISO/IEC 8211 and content model of S-101 should not cause any major issues with SENC delivery.

8.6 Liaison with Trade Organizations

(potential impact on the relation with CIRM, RTCM, RTCA, CNITA, etc.)

8.7 End Users

8.7.1 Development and implementation of S-101

8.7.1.1 Advantages of S-100 ECDIS

Once the viability of the S-57 to S-101 converter has been established through testing it will enable both S-57 and S-100 based ECDIS to run in parallel until either all ECDIS move to S-100 or S-57 data is withdrawn.

Two S-101 Stakeholder Workshops have been held during the development of S-101, primarily designed to ascertain their likes and dislikes of the current ECDIS user experience and to capture their ideas for improving this in the future.

Bearing in mind that the testing phase may influence change, the following are perceived to be beneficial to the overall ECDIS users' future experience. Some are S-101 specific and others are related to the concept of an S-100 enabled ECDIS.

- A new loading strategy will better control the display and scale of data being viewed. The concept of Navigation Purpose is removed and data will only be loaded using maximum and minimum scales for a dataset.
- New feature types and structures which will enable more useful and easier to understand pick reports.
- A new update feature type which will properly pinpoint changes made to data by Notice to Mariner including deleted items.
- A new information type which will enable more precise use of meta information about features and eradicate the need for and over use of caution areas.
- A new cartographic feature which will enable better placement of text and significantly reduce cluttered displays.

- New methodology for calculating and displaying bathymetric quality information which takes into consideration a vessel's parameters rather than a one-fits-all solution which is the current case.
- ECDIS will be capable of more easily accepting and displaying products which supplement the ENC.
- A standardized format for route information will enable the possibility to share routes.

8.7.1.2 Software maintenance

Currently one of the major issues is the inability to make changes to standards which require maintenance of ECDIS. S-101 will include new feature and portrayal catalogues which will enable ECDIS to be automatically updated and eventually eradicate un-maintained legacy systems.

It should also be possible to more easily upgrade production systems using the catalogues.

8.7.1.3 Legacy systems / grandfather clause

The benefits of S-101 will not be fully established until there are only S-100 enabled ECDIS in use. This may require legislative action to achieve.

This also affects the eventually retirement date of S-57 ENCs although their eventual demise could be considered to be a driver in persuading shipping companies to upgrade to S-100 ECDIS.

8.7.2 Development and implementation of other product specifications

This is very much dependant on the environment and system the specification is to be used. For example if this is ECDIS then specifications would have to be developed using the template referred to in section 7 above. This may also apply to other GIS applications developed for e-Navigation.

If S-100 based data is to be used in other environments, for example Web Feature Services, then consideration would be given to extending S-100 if required.

8.8 Liaison with Users' Organizations

(potential impact on relation with ICS, IMPA, BIMCO, CLIA, etc.)

In general, user organizations will probably only be involved or interested in product specifications. As is the case with S-101, users must be actively engaged by means of stakeholder workshops, etc. to ensure any product satisfies the requirements of end users as well as all other stakeholders.