

**Paper for Consideration by S-100WG**

**Summary of progress against Dual Fuel Concept for S-100 ECDIS items.**

<b>Submitted by:</b>	IIC Technologies,
<b>Executive Summary:</b>	Summary of progress against action items
<b>Related Documents:</b>	Dual Fuel Concept for S-100 ECDIS
<b>Related Projects:</b>	S-100 ECDIS implementation

### **Introduction / Background**

The Dual Fuel Concept for S-100 ECDIS document contained an analysis of the core concept, status and progress towards S-100 ECDIS. Although focused on “Chart” management, and dual fuel transition, it was necessary to evaluate a number of aspects of proposed S-100 ECDIS operation in order to look in detail at dual fuel itself.

A number of observations and actions for the IHO community were drafted which contribute to the successful implementation of the dual Fuel concept. This paper, intended for discussion by the S-100WG reviews those actions and progress against them since initial publication of the Dual Fuel Concept document.

It is suggested that an update to these action items could be integrated into a revision of the main document, to serve as a statement of progress at the time of the current S100WG meeting.

### **Analysis**

Annex 1 of this paper contains a transcript of all the Action Items identified during the creation of the Dual Fuel Concept for ECDIS document, and included as section 7 of that document. Progress against these are noted below in the numbered list – the bracketed numbers indicate the source subsections in the document.

1. (7.2). **Revision of applicable IMO Documentation**  
In progress. There are many details but at a high level this is progressing and, from a chart perspective, requires a continuation of effort and support both from member states, the secretariat and WG members.
2. (7.1). **Dataset Equivalentents.**
  - a. Not progressed – This can be addressed within the S-128 group as a formal proposal to map S-57 “versions” against S-101 “versions”. Also will be discussed with the loading strategy group and tested to see if it helps with some of the perceived issues in the current chart loading algorithms.
3. (7.3). **Loading Strategy**
  - a. A complete review of the loading strategy was presented at the recent S-101PT. This was very useful and much progress has been made. It is fair to say that complete consensus has not been achieved but while some disagreements remain, there is enough to test with and then to make changes if they are required.
  - b. Part of the perceived issue is when different scales are side by side then it is challenging to know when to interleave vs overlap. Much has been discussed and published on this topic and it is likely to continue. The current strategy equates max display scale with compilation scale as the fundamental principle governing chart loading strategy. The views of more implementers are certainly required to establish whether the stated issues can be worked around.

4. **(7.4) ENC Co-production Strategies**
  - a. A solid foundation for defining co-production strategies has been made with publication of the S-57 to S-101 conversion guidance document. This is in revision following DCEG/S-101 revision and a new S-101 to S-57 conversion guidance document is also now within the scope of the IHO Sub-WG.
  - b. IHO Lab Singapore should tackle the analysis of converted data and, at least in part provide initial guidance along with analysis of conversion strategies. A recent meeting with the lab has made progress in unblocking resources for the project.
  - c. Obviously, an increasing number of member states are involved in one or more conversion test beds and this will also help contribute to this effort although this is growing in importance for IHO member states
  - d. Software/Tool vendors have obviously made progress in this area as well. No standardised methods exist yet, nor have any been identified in the public domain. This will undoubtedly be an area of focus for 2023.
  
5. **(7.5) Scope of implementation for OEMs**
  - a. S-164 needs to drive this. View is that extent will be defined by the test data available. Nowhere exists to hold this yet as a single landing page although an outline was drafted during the S-101PT. This should be considered a very high priority item.
  - b. S-164 ENC datasets have progressed and have been used for initial S-101 Part 17 exchange sets.
  
6. **(7.6) S-100 product specification overlays on ENC**
  - a. WLA and annex c implementations are the highest priority actions in respect of overlays from the data producer point of view.
  - b. A first IC needs drafting. Some progress has been made on this but it is not widely reviewed yet. A draft model exists in S-98 for how the current priority product specifications should be dealt with by an initial IC..
  - c. Implications for data producers should be considered further .
  - d. Needs control put in place for overlays to ensure coherent behaviour for end users.
  
7. **(7.7) Support to the external communities (including test data provision)**
  - a. Landing page should be progressed as one of the most important items to date. Other pages already exist, e.g. data protection scheme, registry and S-100 resources. A proposal for a landing page was drafted during S-101PT9
  - b. Such a landing page should be the central resource for publishing S-164 test datasets.
  
8. **(7.8) Impacts of Enhanced ECDIS functionality**
  - a. Needs discussion, (this could be a focus for the next TSM) to see if more accessible descriptions of S-100 / S-98 Annex C can be drafted for both data producers and implementers/end user communities.
  
9. **(7.9) How many revisions of product specifications are required to be supported by OEMs?**
  - a. This is drafted as two initially but some clarification is probably a good idea in S-98 as it is reviewed further following implementations.
  - b. S-98 revision will be time critical as most implementations need to commence with S-100 first, with S-98 Annex C following.
  
10. **(7.10) Phasing out S-57**
  - a. No plan as yet.

- 11. (7.11) Impact of Changes to ENC on the end user**
- a. Portrayal has reached milestone. Should an overall impact statement be written? I believe this was raised at S-101PT but not followed up into a concrete action. This should be followed up with S-101PT and a proposal made for creation of such an overall summary when the PC has reached a suitable level of maturity.
- 12. (7.12) How to update S-100 itself**
- a. No progress as yet. Not considered a high priority item.
- 13. 7.13. S-128 development**
- a. Meetings have progressed and S-128 has matured. Two testbeds have made initial datasets of S-128 and reported their findings. Test beds of update Status Reports have also been developed.
  - b. Test datasets and Exchange sets can be constructed now, following test implementations of Part 17.
  - c. S-128 datasets can be updated as well using revised Part 10b mechanisms. More thorough scenario testing of Part 17 is required to fully mature S-128
  - d. All the components are in place for more thorough modelling and testing of complete services which S-128 will fit into.
- 14. 7.14. Categorisation of product specifications**
- a. Suggest the three types contained in the document. This has been the topic of discussion but not a formal proposal yet. Will be proposed to next TSM meeting and documented in the landing page too.
  - b. This has relevance when refining S-98 operating model of which overlays are enabled on which charts.
  - c. Equivalence with publications still outstanding. A recent discussion at CIRM centred on this driven from IMO documentation. Requirement is for IHO landing page to document this unambiguously.
- 15. 7.15. The S-100 ECDIS Operating Model**
- a. Should be embedded into S-98?
- 16. 7.16. Inter-product validation concept or tests are not developed.**
- a. Consideration by validation subgroups this week

#### **High priority items**

- IHO located landing page for S-100 ECDIS implementers to use, combining test datasets, standards and statements of definition and equivalence.
- S-164 test datasets and a group who develop and maintain the test datasets.
- S-98 update and refinements to shape ECDIS implementation
- S-128 content and publication
- Combined dual fuel exchange sets with all components complete and at defined revision levels. (TSM?)

#### **Recommendations:**

The S-100WG is asked to:

- a. Note the contents of this paper
- b. Input any other relevant information

## Annex 1: Summary of identified gaps

This section lists gaps in the current S-100 support, whether within the established standards base or conceptual gaps which require attention to complete the implementation of S-100 and Dual Fuel mode on the ECDIS. Where possible, approaches to filling such gaps has been suggested. All gaps listed in this section have been discussed in the workshops defining the Governance Document. The consequences of not addressing these gaps will be ambiguity in S-100 ECDIS definition leading to possibly erroneous or unintended functionality on S-100 ECDIS. There is a consequent impact on the S-100 ECDIS user experience with the possibility of ECDIS anomalies arising.

### 7.1. Dataset Equivalents.

No comprehensive and complete versioning mechanism currently exists between S-57 and S-101 Charts. This is a complex area because of the structural differences in coverage between S-57 and S-101, and the way coverage is implemented by the ECDIS loading strategy. It is an issue which may require thorough discussion to establish the optimal way forward. During the transition period all producing authorities will be releasing ENC's in both S-57 and S-101 forms. There will, hence, be  $\geq 2$  "versions" of each ENC dataset for any area. Although this relationship is not 1-1 and equivalence undoubtedly exists and there is nowhere in the S-100 hybrid exchange set mechanism to define it.

Moreover, for maximum flexibility for data producers the equivalence is between S-57 M\_COVR/M\_CSCALE features and S-101 DataCoverage features with a many to many relationship.

This lack of equivalence currently defines an area of ambiguity when a hybrid exchange set contains S-57 and S-101 which overlap and may be close in scale. A "versioning" mechanism which defines such a many-to-many relationship between the components of S-101 cells and S-57 cells would remove this ambiguity and enable ECDIS to make clear choices about which data to install (or which data to select from the SENC for its operations). It would also give the data producer more choices of scale and scheming when migrating ENC data holdings from S-57 to S-101.

Such a change necessarily involves referring to both S-57 and S-101 so probably does not belong in any of the S-100 component standards. If a lower level of granularity is settled on (at a cell level rather than a coverage feature level) then the solution is a lot simpler and could be defined either in S-98 or the S-128 product specification both of which are in development. The impacts for data producers on scheming can then be defined accordingly.

A recent meeting of the data loading subgroup has concluded that all coverage features are to be loaded and simultaneously as a single entity. This establishes the "dataset" as the granular element of equivalence and, if agreed, will substantially simplify the task of specifying equivalence between cells.

### 7.2. Revision of applicable IMO Documentation

The IMO PS requires updating to include S-100 as the foundation for ECDIS operation. This has been instigated and the IHO component standards to be referenced are now at version 1.0.0 or later. S-100 Edition 5.0.0 will be the baseline for compatibility with S-100 ECDIS. In particular the equivalence of the S-100 ECDIS for Nautical Publications is not explicit and will also need to be more properly defined as the IMO PS is revised. Following this revision, the relevant testing standards require revision. This is a large undertaking and will also need to ensure that testing for the existing S-57 regime can remain in place (should updates be required).

### 7.3. Loading Strategy

"Loading Strategy" – the mechanism by which individual datasets are selected for portrayal and rendered on screen using the S-100 Part 9 portrayal engine, is still the subject of intense discussion. This is closely related to Error! Reference source not found. and its conclusion will provide a normative method for equating scales between datasets and/or selecting datasets for portrayal from those installed in the ECDIS. Defining a consistent loading strategy for the S-100 ECDIS will also implicitly define whether S-101 or S-57 "versions" of a cell are made available to the end user and whether different datasets are presented "overlaid" or "side by side". This discussion is ongoing

and will result in a definition of loading strategy for the S-101 product specification with likely consequences for S-98 edition 2.0.0.

#### 7.4. ENC Co-production Strategies

The S-57 to S-101 conversion subgroup, set up jointly between the ENCWG and S-101PT is preparing a document recommending guidance for initial conversion of ENC holdings to forms capable of producing S-101 ENCs. There are also many other research activities in operation globally.

There is currently nowhere in scope of IHO working groups an investigation on the optimum method of producing S-57 and S-101 cells on an ongoing basis for data producers and no automated methods for conversion of S-57 incremental updates. This may be addressed in part by the IHO R&D Lab project proposal which will look at the issue in conjunction with a test phase of the conversion guidance document.

#### 7.5. Scope of implementation for OEMs

There is currently no guidance for OEMs with regard to which parts of S-100 require implementation for S-100 ECDIS. Certainly, all clauses required for S-101 and the other initial S-100 product specifications would be required. Conversely, it is also difficult to define which areas of S-100 are definitely NOT required for S-100 ECDIS implementation.

The current approach from the S-100 WG is to demonstrate by example what is required by the creation of extensive and comprehensive test data under IHO S-164. This approach requires consultation with the OEM community and could be enhanced with clarifications on particular areas if required. It does pose challenges though, especially for early adopters who are without representative test data nor a detailed description of scope.

#### 7.6. S-100 product specification overlays on ENC

Discussions around S-100 ECDIS have touched on the topic of whether S-100 products other than ENCs (those in categories (2) and (3) defined in section 2.5) overlay just S-100 ENCs or whether they can also overlay or interoperate with S-57 ENCs as well. This is a topic of specific interest in relation to S-102/S-57 but also has been discussed in relation to other S-1XX products. Additionally, whether WEND100 principles should be “enforced” on the S-100 ECDIS through Part 15 implementations expressed in S-98 Annex C should be discussed within the IHO community as the technical possibility exists. At an early stage of ECDIS development it is possible to make such constraints but once ECDIS is developed it will be unlikely to change.

Such requirements have never existed on S-57 ECDIS because no concept of overlays being used for SOLAS navigation existed. This requires further discussion and an approach defined in (most likely) S-98 with OEMs being given definitive guidance either way.

#### 7.7. Support to the external communities (including test data provision)

One of the items which has become clear from the workshops driving the creation of the Governance Document is the scope and complexity required between the IHO and the implementers of S-100 ECDIS. The complexity of the S-100 ecosystem is considerably greater than that surrounding S-57 and all parties/stakeholders will require support to ensure coherence of produced data with ECDIS implementations is maintained. In order to best support OEMs, testers, data producers, regulators and other implementers of S-100, an open access, scalable infrastructure will be required long term.

A known gap is certainly test data within S-164, which tests the entirety of the S-100 framework as well as test data to test validation specifications. This isn't technically a “gap” as what needs to be done is well known in the community but it is currently a large deficiency which risks the planned implementation timescales and holds up progress by implementers and testbed developers. It is therefore included here as its production is likely to lead to further requirements and change within S-100 and its component product specifications destined for S-100 ECDIS.

#### 7.8. Impacts of Enhanced ECDIS functionality

Features introduced in the S-98 Annex C v1.0.0 include “User Selected Safety Contour” and “Water Level Adjustment”. This is an OEM-specific portrayal and Alert/Indication implementation which provides algorithms for a tight integration between S-101 and either/both S-102 and S-104. Implementation is similar to functionality required by interoperability levels 3 and 4 (which are explicitly excluded for ECDIS implementation) but is, for the purposes of S-100 ECDIS, implemented as a bespoke OEM extension to the required S-100 model implementation.

These features are likely to be accompanied by a number of impacts on data producers. The implementation of such features is a major step forward for ECDIS functionality and those data producers who choose to distribute dense bathymetry and water level data to end users are likely to need to evaluate such impacts. These include:

1. The Liability acquired concerning use of S-102 and S-104 for navigation decisions.
2. Cross product validation.
3. Up to datedness issues – the user must keep the S-102 / S-104 up-to-date in the same way as the S-101 data.
4. Extents and coverage decisions to maximise use and ensure coherent portrayal of data for the end user.

None of these are insurmountable problems but they represent a new category of consideration with attendant governance issues for any implementing data producer in the S-100 era. Feedback from user testing will be required to ensure the concept is well understood by the mariner.

#### 7.9. How many revisions of product specifications are required to be supported by OEMs?

Section 5.2 details the requirement for S-100 ECDIS to support multiple versions of IHO product specifications but little in the way of tangible requirements or implementation details currently exist for this important aspect of the dynamic S-100 ECDIS. Clearly at least two versions are required to be supported by the ECDIS to enable the most basic of updates by the end user and data migration by data producers but the exact number (per product specification) and process for their introduction/migration has yet to be defined.

This is closely linked to the comments made in 2.6.1, the S-100 ECDIS “operating model” and suggests that a more complete picture of how the ECDIS operates should be established (as a summary of the processes defined in S-98, S-164 and the IMO PS) and maintained. Certainly the S-98 Annex C v1.0.0 contains some of this information and comprehensive test datasets will contribute to better understanding but some detailed modelling of scenarios (similar to that proposed in 7.12) would support OEM implementation better at this crucial stage of development.

#### 7.10. Phasing out S-57

No formal description, timescale or sequence of events has yet been put forward for how S-57 is actually phased out at the end of the transition period. There are likely to be a substantial number of external dependencies to this process. The timescales are, of course, unknown, as yet and likely to be some time in the future. If more revisions are likely to be required, e.g. subsequent changes to either SOLAS or the IMO PS for ECDIS then this should be noted for future reference.

#### 7.11. Impact of Changes to ENC on the end user

Initial rollout of S-101 ENCs is likely to release a number of changes in portrayal and, via remodeling, alerts/indications. There is no defined process to establish whether such changes should be included or not and for their impacts to be communicated to end users and data producers. Some initial steps have been taken in this area and, although IHO ultimately has the authority to make such changes, through promulgation of new feature and portrayal catalogues, no bounding set of guidance currently exists to arbitrate these decisions. This should be addressed as it could potentially reduce the amount of effort/resource necessary to meet planned timescales for S-100 ECDIS implementation.

#### 7.12. How to update S-100 itself

Procedures for updates of S-100 will require development, ideally before mainstream implementation of S-100 is commenced by the OEM community. Procedures for update of S-57 and other component standards already exist within the IHO community but S-100 is such a far-reaching standard with its elements embedded in the S-100 ECDIS that greater support is likely to be required, greater consultation and testing required and the attendant update of component product specifications likely to need attention from the working groups concerned. Modelling such scenarios (along with end of life for S-57) should be done prior to more work on ECDIS implementation taking place so that OEMs can be aware of how such migration is likely to take place.

#### 7.13. S-128 development

The S-128 data model is still at an early stage of development with v1.0.0 to be approved by NIPWG. S-128 has been identified as crucial for reliable exchange of S-100 exchange catalogues between service providers and end users for two main purposes:

1. The specification of revision information for a user's service which determines the content of the revised Update Status reports on the ECDIS (contained in S-63 and S-98 Annex C).
2. Mapping of equivalent "versions" of ENCs, should such equivalence be established as part of the conclusion of the loading strategy discussions currently underway.

S-128, ultimately, fulfils the goal of "service metadata" for S-100 ECDIS and each service provider will need to develop compatibility with it in order to present a full service to end users and to satisfy requirements for ECDIS update status reports to satisfy inspection regimes. Lack of a mature S-128 product specification will impact the ability of ECDIS to fulfill SOLAS compliance in respect of tracking update status and management of updates and equivalents under Dual Fuel mode.

#### 7.14. Categorisation of product specifications

In section 2.5 a categorisation of individual product specifications has been proposed. In order to clarify within IHO standards, and for external users there is a need to clarify which of the three categories proposed each IHO product specification falls within. Additionally, in order to provide clarity through IMO requirements, a mapping of IHO project specifications to nautical publications is required. This is not necessarily 1-1 but should state which IHO product specifications map to which category of SOLAS nautical publications so that a firm equivalence can be established between paper and digital products. IHO is able to make such a mapping. This may also require clarity at IMO level to make it clear to end users and inspectors. There is a clear rationale behind the use of ECDIS to satisfy carriage requirements for nautical publications.

#### 7.15. The S-100 ECDIS Operating Model

A complete operating model for S-100 ECDIS is not completely defined. Gaps exist in how the ECDIS is defined at a detailed level in some areas (e.g. dual fuel operations), and at a high level in others (loading, revision, syntax/schema checking/validation).

Some of these gaps will be addressed by S-164 test data illustrating test cases and IEC61174 will define exact test scenarios for some parts of the ECDIS functionality. S-98 Annex C version 1.0.0 contains a definitive list of ECDIS error codes (SSE) inherited from IHO S-63 which define some parts of how the ECDIS is to operate but this is likely to require update and clarification as S-98 is tested.

Data Producer impacts stemming from ECDIS operation should be maintained for IHO stakeholders to assess impacts of proposed changes (and how migration to new versions of product specifications can be achieved).

#### 7.16. Inter-product validation concept or tests are not developed.

Currently no tests exist to validate whether datasets intended for integrated use on S-100 ECDIS are compatible with each other. In addition no process for their development across different IHO project teams exist. Such tests

are a natural consequence of S-100's multiple product specification approach and should be a part of the detailed implementation roadmap towards an integrated operating model under S-100.