



S-100 and the future of ECDIS

Workshop Report

14 & 15 April 2021

Online

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Workshop Convenor

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Executive summary

The CIRM Workshop on S-100 and the future of ECDIS was held online on 14 and 15 April 2021.

Sixty-nine individuals participated in the Workshop, comprising CIRM members and representatives from external organisations having an active interest in the implementation of S-100.

The purpose of the Workshop was to bring CIRM members and external stakeholders together in order to discuss all technical aspects related to the introduction of support for S-100 in ECDIS, and the objective was to identify and shed light on some of the associated unknowns.

Four individual discussion sessions were held, each moderated by a subject matter expert from the IHO's standards development community. Every session featured wide-ranging discussion, with considerable interaction between the speakers and general participants, and between CIRM members and non-members, covering all aspects of the implementation of S-100 including:

- the timescales associated with S-101 ENC coverage and their use in ECDIS;
- the nature and scope of changes to standards including MSC.232(82) and IEC 61174;
- dynamic adjustment of chart data using non-ENC S-100 based product specifications;
- the potential impact of S-100 on user training, ECDIS hardware and data usage;
- definition of SENC & the role of SENC Delivery in S-100 ECDIS;
- the capabilities of the "dual-fuel" concept for S-100 ECDIS; and
- the possibility of encountering S-101 "anomalies".

The conclusions reached by the Workshop are provided in the final section of this Report.

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Background

Comité International Radio-Maritime (CIRM) is the principal international association of companies engaged in maritime electronics, with membership of over 100 companies from 30 nations worldwide. CIRM's membership includes numerous companies with an interest in ECDIS, including ECDIS manufacturers, kernel makers, data providers and service companies.

In 2011, the International Maritime Organization (IMO) adopted the IHO's *S-100 Universal Hydrographic Data Model* (S-100) as the basis for technical harmonization of data services providing navigation-related information exchange. Following maturation of the S-100 framework, the IHO released for evaluation and testing its new product specification for Electronic Navigational Charts (ENCs), S-101, with the stated intent that S-101 ENCs will eventually replace S-57 ENCs.

The timelines associated with the transition to S-100-based ECDIS are currently under consideration, and the concept of "Dual-Fuel ECDIS" has emerged as a necessary stage in the transition, whereby ECDIS will have the ability to load and use ENCs in both S-57 and S-101 formats¹.

CIRM members foresee many benefits to the mariner through the incorporation of data products from the S-100 series into navigational equipment, and CIRM supports the transition to S-100-based ECDIS. At the same time, CIRM members are of the view that in order to ensure a successful transition to S-100 ECDIS, all aspects of that transition need to be carefully considered by all stakeholders, including but not limited to:

- the start date, duration and end date of the transition period;
- the scope of the necessary standardisation work; and
- the technical capabilities of "Dual-Fuel ECDIS".

Overview

CIRM's virtual *Workshop on S-100 and the future of ECDIS* was held on 14 & 15 April 2021.

Sixty-nine individuals joined the Workshop. Alongside CIRM members, participants included representatives from the IHO Secretariat, various IHO technical bodies, national hydrographic offices, national maritime administrations, and Regional ENC Coordination Centres (RENCs).

The programme was split into four discussion sessions, each moderated by a subject matter expert:

1. Overview and progress of S-100 related standards (*Mod: Julia Powell, NOAA*)
2. What will the S-100 ECDIS look like? (*Mod: Tom Mellor, UKHO*)
3. Dual-Fuel ECDIS (*Mod: Jonathan Pritchard, IIC Technologies*)
4. Standardisation work needed to realise S-100 ECDIS (*Mod: Hannu Peiponen, Furuno Finland*)

¹ During the Workshop it was noted that the term "Dual-Fuel ECDIS" does not imply an "interim" version of ECDIS, but a fully functional S-100 ECDIS that is also capable of loading and using older format S-57 ENCs.

Opening

Meeting convenor Richard Doherty (CIRM) opened the Workshop and provided an administrative briefing.

The convenor welcomed participants on behalf of the CIRM Secretariat, noting the large number of CIRM member companies in attendance and expressing special thanks to those representatives of external organisations who had taken the time to participate.

Purpose & objectives

The convenor observed that the main purpose of the Workshop was to gather CIRM members and key external stakeholders together in order to have an in-depth discussion of all technical aspects related to the introduction of support for S-100 in ECDIS, reporting that CIRM supported the transition to S-100 ECDIS on the basis that S-100 data products had the potential to greatly enhance the mariner's experience of ECDIS, improve the voyage planning process, and increase the overall efficiency and safety of ship navigation.

The convenor further observed that because there remained many unknowns or “grey areas” associated with the transition to S-100 ECDIS, a key objective of the Workshop was to attempt to identify and shed light on some of those unknowns.

Session 1: Overview and progress of S-100 related standards

In the first part of this session, a series of speakers provided an overview of the IHO's key S-100-related standards and a report on the progress of development of those standards. The second part of the session featured presentations from representatives of the Regional ENC Coordination Centres (RENCs), providing their perspectives on dissemination of S-100 data.

The moderator for the session was **Julia Powell** (NOAA; Chair of IHO S-100WG).

Presentation: [Overview and progress of S-100 related standards](#)

Julia Powell (NOAA; Chair of IHO S-100WG)

This presentation provided a brief background of S-100 and the IHO's Strategic Implementation Plan, and summarised the status and progress of the IHO's key S-100 related standards.

- S-100 provides the data framework for the harmonised and consistent development of the next generation of electronic navigational products.
- Equipment and software manufacturers implement at the S-100 level and Product Specifications (PS) are tied to different versions of S-100.
- S-100 leverages machine-readable catalogues for ease of updating different PS and navigation systems.
- Edition 5.0.0 will be the next version of S-100. It is intended to encompass everything needed for full S-100-based ECDIS to meet future IMO performance standards, and will include Real Time Data Integration, streaming service delivery, enhanced data portrayal mechanisms, enhanced cyber security, and will be accompanied by robust data validation and test data sets supporting type approval (S-164).
- S-100 interoperability will be addressed by S-98, which will provide for harmonised portrayal between S-101 ENC and other S-100 based PS, e.g. allowing for tide adjustment of bathymetric data (not currently possible in S-57).
- S-100 interoperability provides a clearer navigation picture to the mariner and supports various use cases, e.g. displaying surface current forecast data directly on the ECDIS screen to aid voyage planning.

Presentation: [IHO HSSC – Hydrographic Services and Standards Committee](#)

Magnus Wallhagen (HSSC Chair)

This presentation provided an overview of the IHO HSSC, its role in the development of S-100, and some of the benefits of moving to S-100.

- The Hydrographic Services and Standards Committee (HSSC) is responsible for progressing IHO's technical work and has a number of active Working Groups and Project Teams, including the S-100 Working Group and ENC Standards Maintenance Working Group.

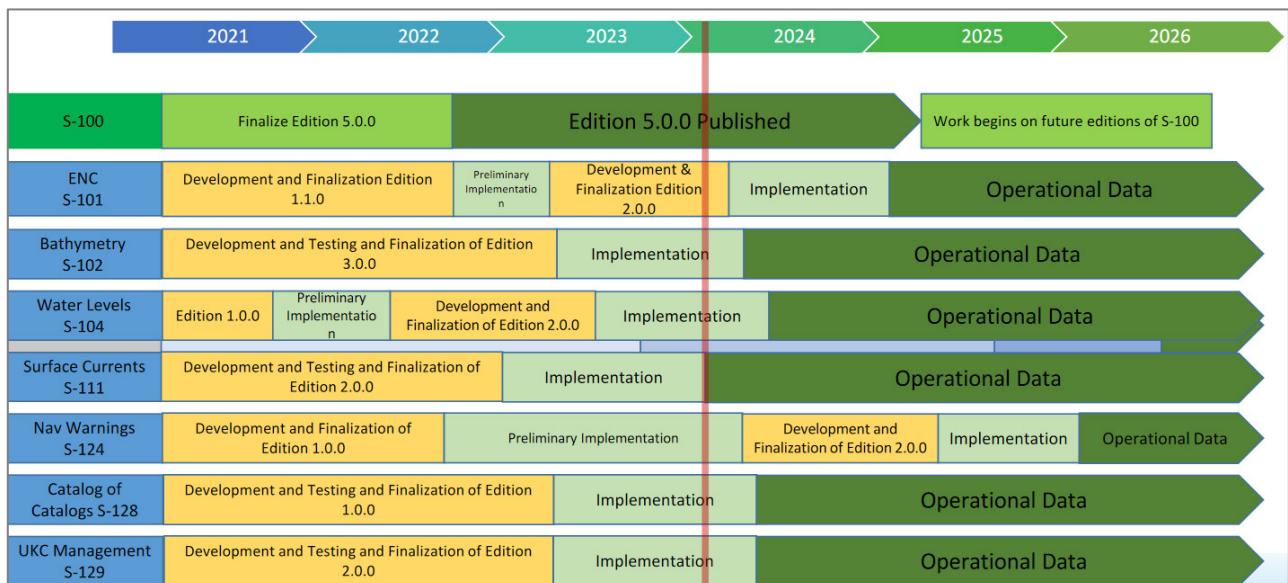
- The current ENC has effectively evolved as an electronic copy of the paper chart and it does not make use of the full possibilities of the digital format.
- S-100 based products are moving from the 2-D format to 4-D, where 3-D is added in the form of high-resolution bathymetry information and 4-D is added in the form of real-time data (e.g. expected/current water level and surface current data).
- The major benefits of S-100 include improved navigational safety, better route optimisation and just-in-time arrival leading to reduced fuel consumption, optimised loading, and support for the future of automated navigation.
- IHO will initially prioritise Product Specifications associated with “navigational route monitoring mode” in S-98 edition 1.0.0, followed by those PS associated with “navigational route planning mode” in future editions of S-98.

Presentation: [S-100 Implementation Strategy](#)

Abri Kampfer (IHO Director Technical Programme)

This presentation focused on the implementation of S-100 through consideration of the IHO’s S-100 Implementation Strategy.

- At its 2nd session in November 2020, the IHO Assembly approved the IHO’s S-100 Implementation Strategy and roadmap (as below), that will be monitored and maintained by IHO, and that identifies a prioritised list of Product Specifications and their related timelines.



- The roadmap highlights that some Product Specifications will be operational before the S-101 ENC, allowing those services to undergo further development in the interim.
- IMO is a key player in the implementation of S-100 and IHO has been engaging with IMO in order to gain acceptance of the use of S-101 ENCs in ECDIS, and although the work at IMO has been delayed, IHO has committed to submit draft amendments for both MSC.232(82) and MSC.1/Circ.1503/Rev.1 to NCSR 9 (2022).

- The roadmap indicates that the S-101 Product Specification will be operational by early 2023, and therefore IHO's expectation is that Hydrographic Offices will be able to make operational S-101 ENC's available from the beginning of 2024.
- Both the ECDIS performance standards (MSC.232(82)) and testing standard (IEC 61174) will have to be updated before ECDIS can use S-101 ENC's. IHO will monitor this work.

In response to actions requested by the presenter, CIRM noted with thanks the development of S-100 based Product Specifications, the impact of decisions of other organizations on the "S-100 roadmap for the S-100 Implementation Decade", and the continued engagement of IHO with IMO with input from CIRM.

Presentation: [PRIMAR S-100 Services](#)

Svein S. Skjaeveland (PRIMAR)

This presentation provided a RENC's perspective on dissemination of S-100 data, focusing on PRIMAR's S-100 services.

- As a RENC, PRIMAR receives ENC data from producing agencies; the data then goes through PRIMAR services and is made available to a chain of distributors, who in turn distribute the data to end users on vessels.
- PRIMAR's S-101 service development project develops existing S-57 data services to also cater for S-101 data.
- Through a Multiple Products exchange set, PRIMAR will package all types of S-100 data together in one delivery, including dataset files, support files and catalogues.
- PRIMAR has been involved in a project to establish a full service delivery chain for S-100 data, with the Canadian Hydrographic Service (CHS) as data producer.
- PRIMAR's S-100 Service launched in July 2020 and currently contains 2,500 coverage areas for S-102 (*Bathymetric Surface*) / S-111 (*Surface Currents*) data from CHS, and will support S-111 data from the US once officially released in 2021.
- PRIMAR has released a S-100 development kit and test data, as well as a S-100/S-101 online training course and e-Learning portal.
- The *S-57 and S-101 Data Conversion Task Force* is a project being established to assess data conversion functionality and provide associated guidance to PRIMAR Member States.

Presentation: [IC-ENC's perspective of S-100 dissemination](#)

Su Marks (IC-ENC)

This presentation provided another RENC's perspective on dissemination of S-100 data, focusing on IC-ENC's upcoming S-100 services.

- IC-ENC's current service provides a weekly release of encrypted S-57 ENC exchange sets to Value Added Resellers (VARs).
- IC-ENC has developed plans for its future S-100 services, the "First generation" of which (2021-2023) will focus on S-101, S-102 (*Bathymetric Surface*), S-122 (*Marine Protected Areas*), Conversion Support,

Data Harmonisation, S-111 (*Surface Currents*) and S-104 (*Water Level Information for Surface Navigation*), with a number of other S-10x services planned for the “Next generation” (2024 and beyond).

- IC-ENC will be utilising S-100 Part 15 for the purpose of encryption and signing, with the S-100 Licensing Model currently being discussed within the IC-ENC Distribution Working Group.
- S-102 is the priority for the first generation of IC-ENC S-10x services and is being trialled in 2021, with a timeline throughput of data of up to 24 hours; S-122 is the second highest priority, expected to have a smaller number of data sets and release frequency.
- An *IC-ENC S-10x Harmonisation service* is being developed to assist HOs in producing a coherent suite of electronic navigation products, ensuring that ENC's are compliant with international standards and readily available to users.

Discussion

Q) When it is realistic to assume real availability of S-101 ENC's? When could the IMO “in-force date” be set?

- *Abri Kampfer (IHO)* observed that the IHO's implementation roadmap indicates when general production of S-101 ENC's is anticipated; IHO expects the operational version of the S-101 Product Specification (version 2) in the beginning of 2023, with some HOs being in full production soon after.
- *Julia Powel (NOAA)* reported that NOAA has been working with production partner ESRI on how to transition from S-57 to S-101 production. NOAA hopes to have preliminary-type services a little before 2024, and the organisation has been getting data out for purposes of testing and development.

Q) The IHO Council's picture suggests that the S-101 operational period starts from the beginning of 2025. Any comment?

- *Abri Kampfer (IHO)* noted that “Operational date” in this sense refers to a time when all testing and validation has been completed. In terms of when S-101 data sets will be available, IHO expects this to start from 2023 with a lot more coming in 2024.

Q) It was interesting to see PRIMAR's approach of “bundling” different S-100 products (S-101, S-102). HSSC has tabled the discussion on Supply Chain Certification until S-101 is ready. Does IHO (HSSC) have plans to revitalize the discussion?

- *Magnus Wallhagen (HSSC)* observed that supply chain discussions are held in the IHO's WEND Working Group, but the answer to this question is “not at the moment”.
- *Abri Kampfer (IHO)* noted that this is a discussion IHO could reinvigorate, but at present there are no plans to do so.

Q) Do we need a rolling programme of S-100 Dual-Fuel ECDIS implementation for SOLAS vessels based on class of vessel - similar to when ECDIS was first introduced?

- *Julia Powell (NOAA)* suggested that we need to first understand the scope of the changes to be made to the IMO performance standards, but expressed the opinion that it will likely involve another rolling programme at IMO. NOAA has recognised that SOLAS will be the last to go because of the IMO

process, but that does not preclude the organisation from offering S-100 services for all the other types of equipment and navigation packages out there, from PPU's to ECSs and so on.

- *Hannu Peiponen (Furuno Finland)* stated that he is keen to find out when it will be legal to use S-101 in an IMO ECDIS without worrying that something has not been completed.
- *Abri Kampfer (IHO)* suggested that when a shipping company has a desire to switch to S-100 ECDIS, they should be able to do so, and we should not be putting limitations on that. IMO will consider S-100 ECDIS to be legal once the full revision of the ECDIS performance standards is completed, and this is not under our control. It is therefore difficult to predict when the IMO portion of this will be completed.

Q) Any chance that we will also see services for non-ECDIS users like, e.g. IC-ENC's current service for S-57?

- *Julia Powell (NOAA)* reported that the US is doing this already, at least with preliminary-type services for things like surface currents.
- *Su Marks (IC-ENC)* suggested that for the non-ECDIS service, this is a great opportunity to utilise S-10x products without the regulatory requirements, and any testing and development in this area will inform the benefits to the end users.

Session 2: What will the S-100 ECDIS look like?

The purpose of Session 2 was to consider what the “S-100 ECDIS” might look like, in terms of functionality, interoperability of the various product specifications, testing and approval, and benefits to the user.

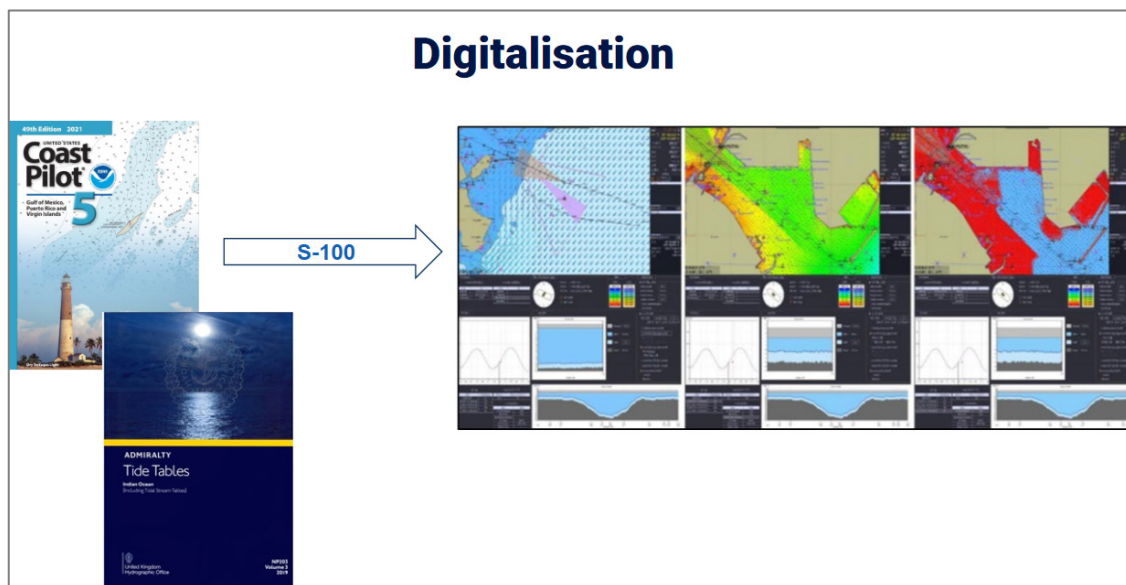
Moderator **Tom Mellor** (UKHO; Chair of IHO ENCWG) provided the presentation for this session.

Presentation: [What will the S-100 ECDIS look like?](#)

Tom Mellor (UKHO; Chair of IHO ENCWG)

Overview of S-100 functionality

- S-100 provides the framework to transform static information currently held in physical nautical publications into interoperable digital layers for use in ECDIS, to improve the mariner’s situational awareness and enhance voyage planning and monitoring.



- S-100 ECDIS will have to manage many more chart information layers and a larger volume of data than existing “legacy” ECDIS, which was designed to display only official ENC data.
- S-100 provides a framework for how the ECDIS will handle the interoperability of the different product specifications, and systems will need intelligent query functions to support users.
- Real-time data streaming into an S-100 ECDIS will enable dynamic updates of information on the ENC, e.g. dynamic adjustment of vessel safety contour and safety depth.
- S-100 products will potentially have update regimes that are very different from the static weekly cycle in use today, with some products being updated much more frequently in certain areas (e.g. S-102 in areas with shifting sand beds).
- A better mechanism for managing the update of ECDIS data products will be introduced with S-100, through the ability to create exchangeable and machine-readable Feature and Portrayal Catalogues

that can be updated, meaning that new content can be introduced without significant delays or the need for manual software upgrades.

Benefits to the user – why S-100 ECDIS will be superior to legacy ECDIS

- S-100 ECDIS will offer numerous benefits to the user when compared to legacy ECDIS, including commercial benefits, safety benefits, and benefits to the environment.
- IHO should work with ECDIS manufacturers to develop a succinct way of explaining to customers how the use of the S-100 ECDIS in conjunction with new data sets will provide these benefits, thereby convincing customers to move to S-100 ECDIS.
- *Planning mode* benefits include Just in Time arrival (voyage optimisation), fuel economy, optimal engine efficiency, emissions control, MARPOL regulatory compliance, and cargo loading.
- *Monitoring mode* benefits include improved navigational safety, reduced risk of accidents/collisions, enhanced chart query functions, and improved metadata for data quality presentation.

Interoperability of S-1xx in ECDIS

- Considering the number of different data sets to be integrated in S-100 ECDIS, rules are needed for how the system is going to handle all of that data and which of the layers take precedence.
- S-100 Part 16 defines a generic interoperability framework; S-98 is the specific implementation of interoperability for S-100 products and is currently under development by the IHO.
- There are 2 types of S-100 dataset under development: *static* datasets for viewing (e.g. S-122 *Marine Protected Areas*), and *dynamic* datasets which can alter the underlying information in the ENC (e.g. S-102 *Bathymetric Surface*).
- Currently OEMs are not permitted to alter the underlying depth information in an ENC – this must be addressed in the associated rules if there is to be a fundamental difference between S-57 and S-100 ECDIS, whereby permission must be granted to calculate safety contours from S-102 or to adjust depths from real-time streaming of tidal information (S-104).

S-100 Products Supported in ECDIS

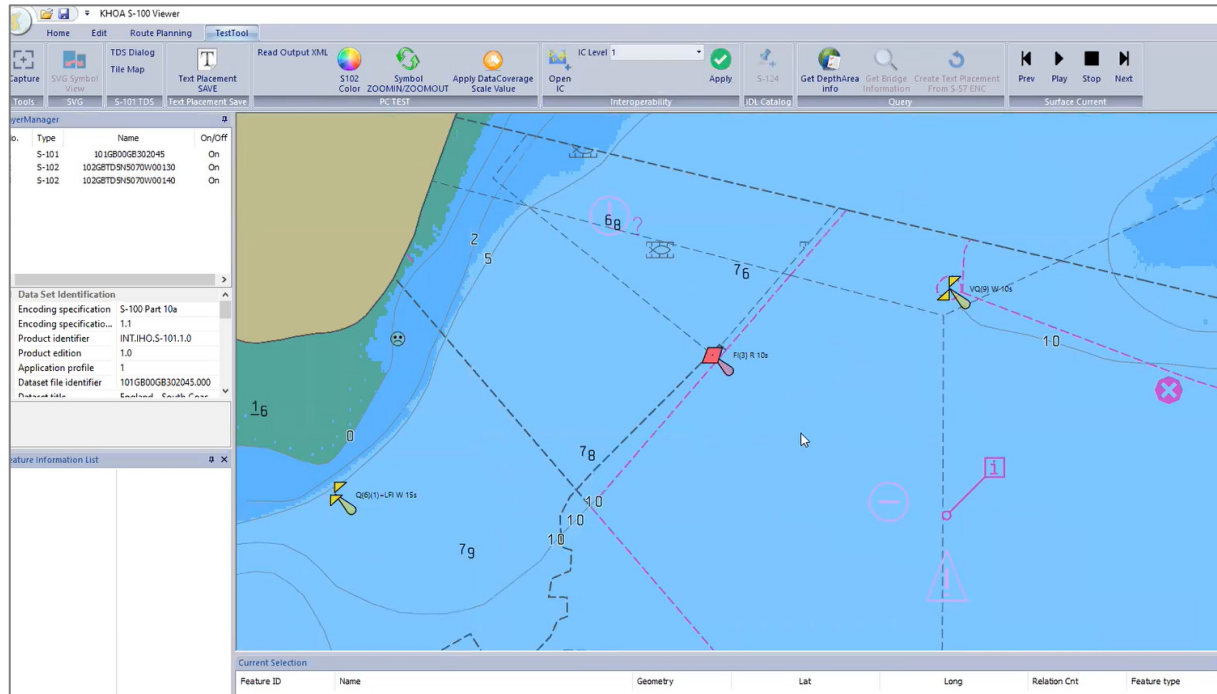
The following list of S-100 Product specifications that must be supported in ECDIS main screen as defined in IHO S-98

- S-101 ENC
- S-102 Bathymetric Surface (Dynamic)
- S-104 Water Level information for Surface Navigation (Dynamic)
- S-111 Surface Currents
- S-124 Navigational Warnings
- S-129 Underkeel Clearance
- S-421 Route Plan

In addition, ECDIS should be able to display by single operator action display of the following data products

- S-122 Marine Protected Areas.
- S-123 Marine Radio Services.
- S-127 Marine Traffic Management.
- S-412 Weather and Wave Hazards.
- S-411 Sea Ice

- There followed a live demonstration by Jonathan Pritchard (IIC Technologies) of S-100 interoperability using the **KHOA S-100 Viewer** <https://github.com/S-100ExpertTeam/khoa-s100-viewer>, during which two levels of operability were explained – firstly, interleaving one S-100 data layer with another (S-102 information with S-101 ENC's, as shown below) and secondly, suppressing a layer within the ENC with a layer from another S-100 data product.



Type Approval of S-100 ECDIS

- The IHO ENCWG is in the process of finalising the S-164 product specification, test datasets to support type approval of S-100 ECDIS.
- S-164 will support the concept of plug and play and will be built on the same principles that have been built into the new version of S-64, to make the type approval process as simple as possible.
- IHO should consider if engagement is needed with Notified Bodies to have them as part of the group developing S-100 ECDIS.

Suggested discussion points

- How should the S-100 ECDIS be promoted to the shipping industry, and what are the key messages?
- Should the IMO ECDIS performance standard be modified to list all S-100 mandatory layers (dynamic/static)?
- Do S-102 and S-104 have to be specifically permitted within the performance standards to modify underlying ENC information?
- How should the IHO engage with Notified Bodies to avoid “bottlenecks” in new type approvals?

Discussion

Q) There are numerous design decisions to be taken in the S-100 roll out. For example relating to adjustment of the safety contour (and safety depth?) with (potentially real-time) S-102 data and/or S-104 tidal data, including consideration of the time-domain. Do we know whether these design decisions are to be taken by IMO, IHO or IEC? Are they to be enforced via S-98?

- *Jonathan Pritchard (IIC Technologies)* expressed the view that the initial operating capability of S-98 will provide what is needed in order to write the interoperability catalogues that will be required by ECDIS.
- *Julia Powell (NOAA)* observed that Edition 1.0 of S-98 is considered the “testing and implementation” edition, and as soon as it is published (2022) the hope is that the manufacturer community will start digging into it, because there will be about 2 years to get to Edition 2.0 which aligns with the S-100 implementation plan of 2024.
- *Simon Cooke (Sperry Marine)* commented that a lot of the design decisions about how these product specifications will interact are being made concrete within S-98, and acknowledged that manufacturers would have 2 years to work with Edition 1.0 before Edition 2.0 was published in 2024.
- *Tom Mellor (UKHO)* expressed the view that dynamic S-100 data sets should be listed alongside S-101 in the revised ECDIS performance standards, because we want to be able to generate alarms and indications from that data, and this would serve to properly differentiate S-100 ECDIS from S-57 ECDIS.
- A number of CIRM Members commented on the need to explicitly list the dynamic S-100 product specifications in the revised ECDIS performance standard.

Q) The interoperability rules seem essential for S-100 ECDIS. What is the timeline for S-98 development and operational availability?

- *Jonathan Pritchard (IIC Technologies)* and *Julia Powell (NOAA)* reported that the IHO is currently going through a set of review comments on S-98 which will continue throughout the summer of 2021, and the S-100 Working Group will finalise the work. Edition 1.0 of S-98 will be ready by January 2022 after which it will go to the HSSC for formal approval.

Q) With the introduction of S-100 ECDIS, how do we cope with user training as related to newly delivered portrayal catalogues? How do we ensure navigators understand and are not confused by having new functionalities, new portrayal etc. which change the behaviour of the ECDIS system?

- *Thomas Mellor (UKHO)* expressed the view that engagement will be needed with the STCW on the training side. What needs to be recognised is control of the feature and portrayal catalogues will be managed by the IHO, and any change will be managed by a certified process.

Q) Should the benefits of S-100 only focus on ECDIS? What about back-of-bridge planning stations, on-shore fleet systems, exchange of data between ship-shore, and so on?

- *Thomas Mellor (UKHO)* agreed that the benefits of S-100 are not limited to ECDIS, and suggested that the unregulated, non-ECDIS systems will be the first place where users will start interacting with S-100-based data.

Q) How will data delivery (real-time streaming) be verified and assured (by RENC and User) in terms of voyage monitoring, when changes affect the already-approved voyage plan?

- *Thomas Mellor (UKHO)* acknowledged that verification of real-time data was an important consideration. We need to consider what the role of the RENC is in this, as it seems improbable that we will have a system that can verify real-time data through a RENC and get to the vessel in real-time. It is important to consider how to provide assurance the data coming from the sensors isn't spurious and that it will not cause a dangerous situation. In S-100 we should not be relying on one source for a real-time feed, as multiple sources will provide redundancy and assurance that the values being received are within expected levels.
- *Julia Powell (NOAA)* suggested that the first goal in the S-100 ECDIS context is to be able to perform water level adjustments based on forecast data versus real-time data, but trying to do real-time dissemination on the 6-8 minute timescale does not seem very feasible for the RENCs, as it introduces too much latency. However automated validation is currently being worked on, as a lot of this work can be done by a machine rather than by a person looking at the data.
- *Hannu Peiponen (Furuno Finland)* observed that another solution is the S-129 model (*Under Keel Clearance Management*), based on high-volume and real-time data managed by a shore-based server. The server updates much easier and in much smaller volume, tailor-made for each vessel.
- *Tom Richardson (IC-ENC)* agreed that there are a lot of unknowns here, and suggested that it may be that the RENCs do not validate the data, but instead validate and test the system that streams the data, so that they are validating a different part of the process. In some cases the real-time data might not ever go to the vessel in that form, and it might be the derived products such as S-129 that are getting the real time data.

Q) IMO's ECDIS Performance Standard states "*It should not be possible to alter the contents of the ENC or SENC information transformed from the ENC.*" Is S-102 and/or S-104 data considered part of the SENC, or outside the SENC?

- *Julia Powell (NOAA)* expressed the view that S-102 and S-104 will have to become part of the SENC, and that needs to be made clear.

Q) Will the integration of S-101 and S-102 be done by the OEM or by the Service Provider (in case of SENC Distribution)?

- *Julia Powell (NOAA)* suggested this would, at a minimum, be done by the OEM, and noted that we don't yet know what SENC distribution will be in the future.

Q) Are there any thoughts about the amount of data an S-100 ECDIS will need to hold compared to an S-57 ECDIS, and the amount of data transfer needed, in order to take advantage of the S-100 ECDIS' benefits?

- *Thomas Mellor (UKHO)* reported that a real assessment of the amount of data the S-100 ECDIS is going to have to cope with has not yet been undertaken. We know from the Product Specifications

the maximum cell size for each of those products, but how many are going to be generated from the data is unknown. For example, S-102: for the top 2,000 ports where we see most traffic, you will have 2 to 3 high resolution surveys where S-102 data has been created, but you don't need S-102 data for the middle of the ocean, meaning that you'd have 5,000 to 6,000 S-102 data sets.

- *Michael Bergmann (Safebridge)* noted that a testbed had looked into this in the German Bight and Elbe River, involving bathymetric, water level and current data, and had found that due to the substantial amount and size of data streams generated, the testbed could only cope by customising data transmission to ships based on their route, so that no ship received the full set of data.

Q) How should the IHO engage with Notified Bodies to avoid “bottlenecks” in new type approvals?

- *Michael Bergmann (Safebridge)* agreed that there is a need to involve Notified Bodies up front, because a harmonised interpretation of what is coming across all Notified Bodies is of critical importance.
- *Thomas Mellor (UKHO)* suggested that having Notified Bodies involved will at least ensure they all start from the same position and have the same understanding of what the intent from the IHO was when it comes to approval with the chart related information
- *J.P. Dionne (OneOcean)* suggested that there are 3 levels to approval - the HO producing the data; the OEM for the systems supporting the new data streams; and training for mariners on how to use the data.

Session 3: Dual-Fuel ECDIS

The focus of Session 3 was the concept of “Dual-Fuel ECDIS”, meaning a system capable of supporting both S-57 ENC data and S-100 ENC data, which is seen as a key step in the transition to S-100 ECDIS.

The aim of this session was for the CIRM community to consider what has been developed so far and for the IHO community to gain feedback that could then be taken to the IHO Working Groups developing the standards to support Dual-Fuel ECDIS.

Guest moderator **Jonathan Pritchard** (IIC Technologies) provided the presentation for this session.

Presentation: [Dual-Fuel ECDIS](#)

Jonathan Pritchard (IIC Technologies)

Dual-Fuel ECDIS capabilities

- The full transition of all ENC providers to S-100 will not be complete for many years, and the transition of the end user community to systems capable of supporting S-100 data for navigation will be incremental.
- The fundamental concept of Dual-Fuel (DF)-ECDIS is to provide a platform for users when both S-100 and S-57 data can be used to support regulatory-compliant navigation.
- DF-ECDIS is at an early stage of definition and its components are not completely defined yet.
- In DF-ECDIS, S-57 and S-101 data can be loaded and used simultaneously (“S-101 ENC where coverage exists, S-57 ENC where it doesn’t”); DF-operation is split/partitioned between the two data types, with no integrated functionality required and no modifications to existing S-57/S-52 (e.g. S-10x data layers will only sit above S-101 ENCs).

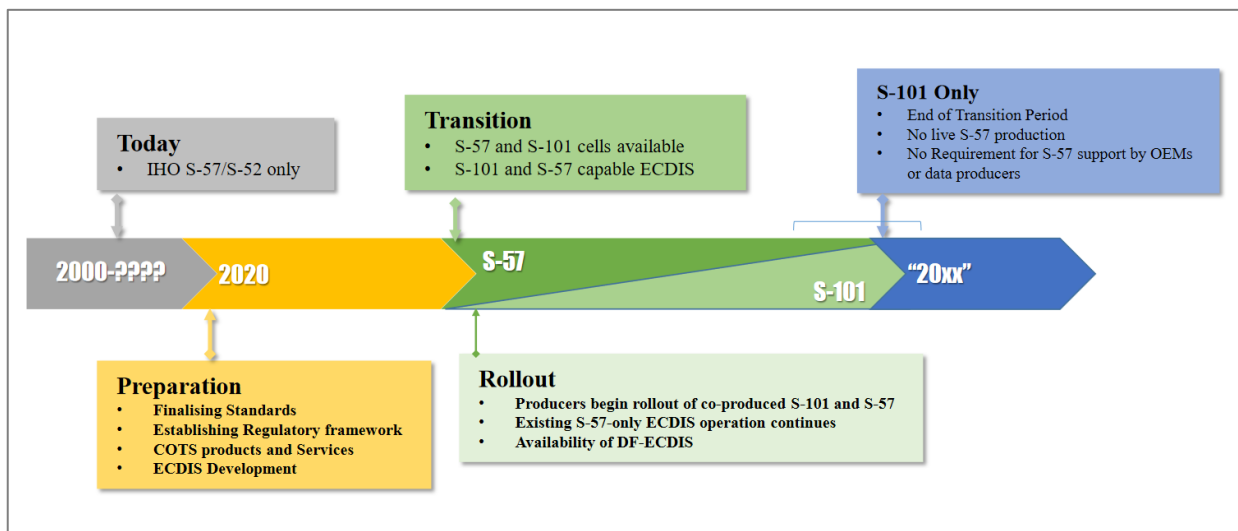


Principles of operation

- DF-ECDIS should allow unambiguous and standardised import and use of both S-57 and S-101 data; in addition, a selection of S-100 compliant data products should be able to be imported and used to enhance user functionality and safety.
- DF-ECDIS behaviour should not be any less “safe” and the requirements of the IMO performance standards should be met in all eventualities.
- User Experience should never be negatively impacted by the introduction of any S-100 compliant data to the ECDIS.

Timelines

- Development of S-100-capable ECDIS is currently in the “Preparation” phase (see diagram below), involving the finalisation of standards, the establishment of the regulatory framework, the development of COTS S-100 products and services, and development of DF-ECDIS.
- The “Transition” phase will begin as soon as a single S-101 cell is released by an IHO Member State (likely in 2024); from that point the volume of S-101 cells available for navigation will start increasing, existing alongside the S-57 cells covering the same areas (“co-production of cells”).
- Concurrent with the “Transition” phase will be the “Rollout” phase, beginning once the co-production of cells is underway, in which DF-ECDIS will become available to support both S-57 and S-101 ENC; throughout this phase existing S-57-only ECDIS will continue in operation.
- There will then come a point when ECDIS can become “S-101 Only”, marking the end of the “Transition” period, by which all users have moved away from S-57 and all ECDIS can use S-101 data, and from which there is no longer a requirement for S-57 support by OEMs or Data Producers.



Development of DF-ECDIS

- DF-ECDIS is for the transitional period only, when coverage of S-101 data is incomplete.
- Data Producers will continue to support full S-57 coverage whilst S-57-only ECDIS are in use on ships.

- DF-ECDIS will be a complete implementation of S-100 ECDIS (S-101 plus all S-100 products).
- S-164 will be developed to provide support for IEC 61174 testing, and will include: full S-101 testing including new functionality (loading/update of feature, portrayal and interoperability catalogues); other S-100 data products (S-102, S-111, S-122 plus others); and “co-existence” testing of representative S-57 data alongside S-101 data to test the DF-ECDIS’ capabilities.

Current working view - development of DF-ECDIS

- To avoid additional revisions to regulatory instruments, DF-ECDIS will have the functionality of an S-57 ECDIS plus the full functionality of an S-100 ECDIS.
- S-101 (ENC) will remain the fundamental base layer, sufficient for safe navigation, enhanced by other products on an incremental basis (in some areas there may be local regulations mandating carriage of “other” S-100 products, e.g. S-102).
- ENC producers will be ready to co-produce and support S-57 and S-101 data in some areas by 2024.
- The IHO standards community can provide comprehensive, representative test data to support ECDIS development.

What is required (practical/regulatory)?

- Revisions to the IMO’s ECDIS performance standards (MSC.232(82)) will be required to cover new capabilities (“Additional Layers”, S-100 and S-57 operation).
- IEC 61174 revision will be supported through development of S-164.
- Infrastructure is also required for Data Production and data Distribution.

Discussion

Q) S-101 is to have priority over S-57 in DF-ECDIS. “*Independent of available compilation scale*” is not a good idea. How do we know when S-57 is better or even the largest scale available? True S-101 has defined “loading strategy”, but S-57 lacks that. So how do we compare?

- *Jonathan Pritchard (IIC Technologies)* observed that S-101 will introduce a much more detailed loading strategy for S-101 data, and the idea of “usage bands” will be dropped from S-101, so it aims to be a much more prescriptive algorithm for what is called loading strategy. Ultimately S-101 and S-57 are both scaled products and they share the concept of largest scale. However the loading strategy of when things actually appear on screen within DF-ECDIS is something that has to be filled in and is currently under debate in the standards community.

Q) Regarding the phrase “*S-101 where coverage exists, S-57 ENC where it doesn’t*” - do we need the ability to revert to S-57 to mitigate the risk of S-101 anomalies in the early days? If S-101 always has priority this may be prohibited? Are we mandating that the mariner wouldn’t be able to revert back to use S-57 data?

- *Jonathan Pritchard (IIC Technologies)*, referencing the DF-ECDIS *Principles of Operation*, noted that the DF-ECDIS shouldn’t be forced to choose between the two data products. Possibly there could be an override whereby if both products are available you could choose to have S-57 instead of S-101, however the aim is that the primary charting product is S-101 and the goal of the next few years in

terms of development is to ensure that the S-101 product is at least as safe as the S-57 product. S-57 should not become a de-facto backup for S-101.

- *Hannu Peiponen (Furuno Finland)* commented that whilst the object model and content of S-101 are as safe as S-57, a concern relates to possible "anomalies" emerging after the initial implementation of S-101.
- *Tom Richardson (IC-ENC)* commented that, regarding possible "anomalies" in S-100 ECDIS, a benefit of the machine-readable catalogues is intended to reduce much of the interpretation that has led to anomalies in the past. Whilst this cannot fully resolve the risk, comprehensive testing both in the development phase and in type approval will be vital.

Q) When adjusting S-101 chart data on a Dual-Fuel system (e.g. for tide), would that be acceptable when the S-57 part of the display is not also adjusted? Is that situation clear to the operator?

- *Jonathan Pritchard (IIC Technologies)* reported that the topic is currently under discussion, but his understanding is that the two types of chart (S-57 and S-101) will be displayed side by side, but where S-102 data is available, the tidal adjustment can only be done on the S-101 chart. Making the situation clear to the operator is going to be a core task facing the standards-setting community.
- *Pål Hansen (TELKO AS)* expressed the view that providing a combined S-57 and S-101 chart display, where some displayed depths are adjusted with tide and some displayed depths are not, is risky

Q) Why could S-102 information (*Bathymetric Surface*) not also be used to adjust an S-57 ENC, as S-102 data replaces S-57 depth areas as well as S-101 depth areas?

- *Jonathan Pritchard (IIC Technologies)* expressed the view that in the case of S-102, it would be possible to replace S-57 depth areas with S-102, but with other S-100 data products where the object model is not equivalent, it could be difficult. It is not recommended to mix S-100 functionality into S-57, because this might confuse the user. There is also a responsibility on Data Producers to ensure that when they release S-102 there is an accompanying S-101 ENC that sits behind it.
- *Eivind Mong (Canadian Coast Guard)* pointed out that it is planned obsolescence to only mix S-100 products with S-100 products and leave S-57 alone.
- *Hannu Peiponen (Furuno Finland)* commented that S-102 is the same as the "bathymetric layer" of Additional Military Layers (AML). S-104 is obviously intended to work with S-102. Therefore S-102 alone or S-102 plus S-104 together could be over S-101 or S-57.
- *Eivind Mong (Canadian Coast Guard)* commented that while using S-57 or S-101 synonymously is technically possible, the workload in regulatory and standard maintenance would be nearly double. It's therefore not sustainable, and that is a reason why there must be a clean separation.
- *Julia Powell (NOAA)* clarified that some data products, including S-102, will be available well before S-101, so there has to be a distinction between what the ECDIS can do as opposed to all of the navigation equipment/systems that aren't ECDIS. There is a full intention to use S-102 with S-57 in things like PPU and ECS, well before there is a transition to a full S-100-based ECDIS.

Q) In a dual fuel world, will users have to purchase both products separately or will they be provided both datasets at the same time?

- *Jonathan Pritchard (IIC Technologies)* suggested that commercial decisions will be down to the distribution chain, and the RENCs are considering how to distribute both types of data in parallel, as there will be users who are S-57-only, and users who have S-100 capability. If DF-ECDIS has to decide what data to load, it should load the S-101 by default.
- *Svein Skjaeveland (PRIMAR)* reported that PRIMAR, as demonstrated in the presentation on Day One, plan to support the multiple product exchange set option, meaning that S-57, S-101 and other S-1xx data could be provided in one delivery.
- *Tom Richardson (IC-ENC)* reported that currently IC-ENC envisages provision of exchange sets for each product type allowing service providers to create their integrated services with full flexibility. However IC-ENC will develop the capability to provide combined exchange sets if that is the preferred approach.

Q) What are your expectations for the hardware on board vessels (i.e. the computers running the ECDIS). There are some pretty old machines out there. Will they be able to handle the potential increase in data and the constant switching back and forth between formats?

- *Jonathan Pritchard (IIC Technologies)* acknowledged that a lot of the hardware in use today is dated and will struggle with moving to S-100 ECDIS, which is in effect a display processing machine that must interpret portrayal, feature and interoperability catalogues and produce a harmonised portrayal. CIRM's manufacturer members are best placed to feed back on this.

Q) We've already seen a Dual-Fuel system, between paper-based navigation and the first generation of ECDIS, with two completely different skill sets needed to navigate on each. Is that something we're going to see again with DF-ECDIS?

- *Jonathan Pritchard (IIC Technologies)* noted that there is a lot of similarity between S-57 and S-101 and no intention to redevelop the portrayal/behavioural mechanism of the ECDIS, and so there should be minimal risk of this.

Q) Will Hydrographic Offices (HOs) really support production of S-57 and S-101 at the same time?

- *Jonathan Pritchard (IIC Technologies)* observed that co-production is certainly the model being talked about now amongst HOs, and they are currently looking into the different models alongside each other and figuring out how co-production can best be done.
- *Hannu Peiponen (Furuno Finland)* noted that IHO cannot force any sovereign member state to move to S-101 at a given date, and member states operate based on their resources and budgets.
- *Magnus Wallhagen (HSSC)* reported that IHO member states are committed to having dual production of S-57 and S-101 ENC's. It is true that IHO cannot force member states to produce in S-101, but most of them are committed to it, and resources are being put into this from the RENC side to support member states.
- *Jeff Wootton (IHO)* commented that HOs will have to support both data formats as long as there are S-57-only ECDIS being used at sea. The hope is that both formats will be exported from a single database.

Q) If S-57 data will continue to be available until the end of the “transition period”, is it necessary to make Dual-Fuel support mandatory, or can shipowners be given the choice to switch over to S-100 ECDIS once S-101 coverage is sufficient (for their area of operation)?

- *Jonathan Pritchard (IIC Technologies)* agreed that this was one of the key questions, and expressed the view that DF-ECDIS will probably have to be made mandatory at some point. It is true that Data Producers will be co-producing chart data in both types for their areas, but S-57 is really for ships with pre-S-100 ECDIS. There has to be a point from which all new ECDIS being installed should be S-100-capable, even if it is not strictly necessary for all ships because S-57 charts are still available.

Q) Reducing the length of the transition period will reduce maintenance costs for all stakeholders – how can we minimise the period?

- *Julia Powell (NOAA)* observed that the Dual-Fuel ECDIS concept is a relatively new one, introduced to the IMO only a year and a half ago; we are therefore still in the infancy of scoping out the concept. We know what we mean by “Dual-Fuel ECDIS”, and now IHO should build out a “governance document” on the DF-ECDIS concept, to capture some of these discussions points on paper. The value of this Workshop is getting input from OEMs on the DF-ECDIS concept.

Q) What are the potential legal ramifications if a vessel has an accident whilst using an S-57 chart when a more accurate or complete S-101 chart was available?

- *Jonathan Pritchard (IIC Technologies)* suggested that when a Data Producer puts out two datasets for the same area, in different forms, there is an amount of acquired liability from the Data Producer to make sure that those two datasets satisfy their obligations in similar ways, to be at least as safe as each other; hence the underlying DF-ECDIS principle that it should not be any less “safe” and the requirements of the IMO performance standards should be met in all eventualities.
- *Julia Powell (NOAA)* commented that it depends on what the HO deems is critical for navigation, and observed that there is a similar problem between ENC’s and paper charts where the ENC is more up to date than the paper version.

Q) Will users be able to tell the difference between an S-57 ENC and an S-101 ENC?

- *Jonathan Pritchard (IIC Technologies)* suggested that users will be able to tell the difference. The presentation is very similar but not identical to the extent that they would be indistinguishable.

Q) There remains so much unclear about how DF-ECDIS should work. Is there enough information to start drafting the (Rules for the) implementation scheme?

- *Jonathan Pritchard (IIC Technologies)* made reference to the “governance document” on Dual-Fuel ECDIS, planned for development within IHO, which will become the first part of the detailed specification of the DF-ECDIS concept. At the present time, the DF-ECDIS “Principles of operation” and the current working view are informing the work, and a lot of discussion is ongoing amongst the IHO community.

Q) Would the technical work of IHO benefit from more active participation from representatives of OEMs and kernel makers?

- *Jonathan Pritchard (IIC Technologies), Tom Mellor (UKHO) and Julia Powell (NOAA)* all emphasised the need for manufacturers to become more actively involved in IHO's standards development work, noting that there has been a gradual decline in such participation over recent years, and urged all CIRM members to get involved in this important work and contribute their critical expertise.
- A number of participants supported the idea of holding OEM-focused sessions within the IHO's S-100 Working Group and/or ENC Maintenance Working Group, in order to look into the technical details of some aspects of the implementation of DF-ECDIS and form a consensus across industry participants.

General comments on the DF-ECDIS concept

- A number of participants agreed with the conclusion that "Dual-Fuel ECDIS" should not be seen as an interim ECDIS, but as a fully-functional S-100 ECDIS with the capability of loading S-57 ENCs.
- *Julia Powell (NOAA)* observed that the IHO standards community intends to specify what is expected from a DF-ECDIS (i.e. behaviour and presentation), but does not seek to specify "how" to implement DF-ECDIS, because that is in the hands of the manufacturers, and the standards community does not wish to be overly-prescriptive and thereby stifle innovation.

Session 4: Standardisation work needed to realise S-100 ECDIS

The purpose of Session 4 was to consider the scope and nature of the related standardisation work that would be needed in order to facilitate the introduction of support for S-100 in ECDIS, taking into account relevant IMO, IHO and IEC standards.

Moderator **Hannu Peiponen** (Furuno Finland; Chair of IEC TC 80) provided the presentation for this session.

Presentation: [Standardisation work needed to realise S-100 ECDIS](#)

Hannu Peiponen (Furuno Finland; IEC TC 80 Chair)

IMO and SOLAS

- Today an ECDIS loaded with adequate and up-to-date S-57 ENC is accepted as meeting the SOLAS carriage requirement for **nautical charts**, however it is not clear that electronic nautical publications can be accepted as meeting the SOLAS carriage requirement for **nautical publications**, because there is no IMO performance standards, guidance or unified interpretation covering this² or specifying the acceptable back-up arrangement for electronic nautical publications.
- Regarding the role of ECDIS, it has to be decided whether ECDIS should support all of the wide-ranging targets of the IMO's e-navigation vision, or a subset of those targets.

S-100 Playground

- In S-100 ECDIS, the nautical chart is represented by the S-101 ENC (the S-102 bathymetry data product could also be considered part of the nautical chart).
- Nautical publications are represented by the other S-100 data products provided by Hydrographic Offices, e.g. S-104 (*Water Level Information for Surface Navigation*) and S-111 (*Surface Currents*).
- Maritime Safety Information (MSI) is represented by several S-100 data products including S-124 (*Navigational Warnings*) and weather-related products such as S-411 (*Ice information*).
- Shore-based under keel clearance (UKC) is supported by S-129 (*Under Keel Clearance Management*), route plan exchange is supported by S-421 (*Route Plan*), and Just-in-Time arrival is supported by S-211 (*Port Call Message Format*).
- There are a number of S-100 product specifications that are not intended for the end user but to support the S-100 infrastructure, including S-98, S-128, and S-164.

Amendments to MSC.232(82) – nature and scope of work

- [Slides 12-18](#) provide a detailed analysis of the content of the ECDIS performance standards MSC.232(82) related to support for S-100 in ECDIS.

² IMO circular MSC-MEPC.2/Circ.2 ("IMO requirements on carriage of publications on board ships") states "publications may be carried in the form of electronic media such as CD-ROM in lieu of hard copies". While this suggests that electronic nautical publications may be used as a means to meet the carriage requirement for nautical publications, to date there has been no detailed consideration at IMO of the use of electronic nautical publications, nor any development of related performance standards, guidance or unified interpretation, and major issues such as back-up arrangements remain unaddressed.

- Dual-Fuel ECDIS is the “great unknown” – how S-57 and S-10x should work together in a single ECDIS.
- We need to consider how much detail to add to MSC.232(82) to guarantee proper implementation of S-100 (e.g. allowing a tidal and water level dynamic adjustment to be performed in ECDIS), how to identify which S-10x products are essential and to ensure they are included in the implementation of an S-100 ECDIS, and how to ensure mariners are trained in the new concepts and functionality.
- MSC.232(82) could be amended using the “footnote style”, where footnotes are updated to include reference to S-100 product specifications, or by a different style where e.g. the body text is amended.

IHO standards – work remaining and timescales

- [Slides 25-34](#) provide a detailed analysis of the work remaining to be done on IHO standards related to support for S-100 in ECDIS.
- The major S-100 product specifications, including the S-100 baseline standard, all have a number of open items critical to ECDIS and a considerable amount of work to be done.

IHO work remaining – S-100 baseline

S-100

- Current edition is 4.0.0
- Planned “Operational” edition is 5.0.0
- Open items critical to ECDIS
 - Alerts and indications not yet included
 - Changes to Portrayal part based on testbed feedback
 - Masking of spatial line not yet included
 - Interpolation of long loxodromes and orthodromes
 - SVG symbols definitions miss support for palette (day, dusk, night)
 - Completion of Data distribution related details
 - Completion of Cyber security related details
 - Updates for GML encoded S-10X products
 - Changes to HDF-5 encoding (location of data point in a cell of the grid)
 - Method of cancellation of a dataset
 - Details of maritime resource names (MRN)

- The S-98 interoperability specification is essential for mixing multiple S-100 products but it remains partially theoretical with many ideas still to be discussed – it is not included within the IHO’s implementation roadmap timeline.
- The S-164 test data set is important to properly test S-100 ECDIS however it is not included within the IHO’s implementation roadmap timeline.

Revision of IEC 61174 – nature and scope of work

- [Slides 37-87](#) provide a detailed analysis of the content of the ECDIS testing standard IEC 61174:2015 related to support for S-100 in ECDIS.
- There are a considerable number of issues to be addressed when revising the current content of IEC 61174:2015, some of which are minor and some highly complex, with a huge amount of drafting work needed to prepare the revision.

Current content of IEC 61174 related to S-100 issues 8

Current clause	Notes
4.18 Default control setting and saved user control settings Table 3 - Control settings configured in response to 'Default' selection	<ul style="list-style-type: none"> Table 3 is based on IMO MSC.252(83) and it contain default values for user selectors Current table include following S-52 related selectors <ul style="list-style-type: none"> Display category Chart related selector: Accuracy Chart related selector: Date dependent objects Chart related selector: Highlight date dependent Chart related selector: Full light lines Chart related selector: Highlight info Chart related selector: Highlight document Chart related selector: Unknown Chart related selector: Scale min Chart related selector: Shallow pattern Chart related selector: Shallow water dangers Chart related selector: Contour labels, if provided Chart related selector: Four shades, if provided Chart related selector: National language, if provided Chart related selector: Paper chart / Simplified symbols Chart related selector: Plain / Symbolized boundaries Chart related selector: Text group layer To be amended to be S-100 compliant

- There are also new items to be addressed in the revision of IEC 61174:2015, and it is not yet clear how to do this – including calculation of safety contour (new functionality of time/date dependency), time/date dependent S-10x overlays, and Dual-Fuel ECDIS.
- The timeline associated with the work to prepare a new version of IEC 61174 involves multiple stages and takes a minimum of three years. The process would benefit from a Preliminary Work Item (PWI) being agreed by the IEC TC 80 meeting in autumn 2021, which would allow the Maintenance Team (MT7) to begin work on the S-100 compliant revision of IEC 61174.

Consideration of a realistic roadmap for this interrelated work

- [Slides 91-97](#) outline, **for illustrative purposes**, potential timelines related to the standardisation work needed to introduce support for S-100 in ECDIS, alongside some associated issues.
- The “ideal timeline” from the ECDIS manufacturers’ point of view involves the fewest steps, with all IHO standards in place and all S-100 data available (including real-time streaming services) before the IMO rules are set based on existing services, after which the IEC standard becomes available for type approval, followed by the arrival of the new generation S-100-compliant ECDIS, and lastly the IMO’s entry-into-force date for carriage of S-100 ECDIS.
- The “nightmare timeline” involves many more steps, with standards and services taking longer than envisioned to finalise and the IMO rules subsequently being set based on theory. In this scenario ECDIS manufacturers could be forced to hurry to make S-100-compliant ECDIS available to meet the IMO’s entry-into-force date for carriage of S-100 ECDIS, before the IEC standard is available for type approval or all the IHO’s S-100-related standards are ready, and could be required to undertake a major upgrade of existing S-100 ECDIS in future to comply with those standard finalised at a later date.

Critical issues related to the standardisation work

- It is critical that testing of S-100 ECDIS through S-164 is conducted before introducing systems to the end user, and this necessitates availability of test data, test instructions, and expected results.

- Defining the rules around Dual-Fuel ECDIS is another critical issue to solve – how DF-ECDIS should work, what functionality should be available, etc.

IHO, IMO or IEC – who should be first?

- Logic suggests that IHO should be first to finish its S-100 standards, as without those there will be no S-100 ECDIS, but it seems unfeasible that IHO will be able to complete everything before introduction of S-100 ECDIS to end users.
- IMO was very early completing its work related to the introduction of S-57-based ECDIS, however the nature of the amendments to MSC.232(82) will depend in part on the IHO's S-100-standards.
- IEC 61174 is a testing standard for compliance with IMO and IHO rules, so IEC cannot be first to complete its work.
- It is not clear that any one organisation can be first, as the timelines between them are interconnected, and compromise is therefore inevitable. Likely each of the organisations has a role to play in being first in some aspect of the work.

Discussion

Q) The definition of “SENC” in S-100, and which product specifications might be understood to be part of the SENC, are considerations that need to be at the forefront of our minds as we revise MSC.232(82). If S-101 provides equivalence to S-57, then S-102 is presumably over and above the chart carriage requirements, any re-drafting needs to take that into account.

- *Hannu Peiponen (Furuno Finland)* observed that the IMO's definition of SENC is more than just conversion of the S-57 ENC into the system format, as it includes information from other sources, and one could understand that it refers to the full database including S-101, S-102, S-104, and even all the nautical publications. However in the IHO domain, “SENC delivery” has always been understood to mean only the S-57 conversion into the system format.
- *Simon Cooke (Sperry Marine)* agreed that there are different understandings of the definition of SENC, and the IMO definition does allow for other nautical information. As we go through this and amend the standards documents, we need to be sure that there is a consistent approach.
- *Tom Mellor (UKHO)* reported that there is a view amongst some IHO member states that SENC delivery might not be desirable for S-100 products, but the majority view is that it is premature to decide that SENC delivery will not be needed in S-100, given that we don't yet understand the volume of data involved and how system performance will be impacted with loading of data, etc. Input from manufacturers and testing feedback will give us more information on this so that we can later make an informed decision about SENC delivery in ECDIS.
- *Hannu Peiponen (Furuno Finland)* suggested that the solution is straightforward – provided SENC delivery does not prevent the on-board machine from directly accepting “non-SENC delivery” data to update the content of the SENC, then it should not be an issue.. However if it is not possible to get anything into the target system without first putting it through the SENC pipe, then that is not acceptable.

- *Ronan Pronost (SHOM)* commented that SENC delivery in S-100 might cause cyber risk due to the multiplication of steps between the Producer and the user on the ship, and the relative lack of security in S-63 compared to S-100 Part 15
 - *Paul Elgar (NAVTOR)* responded that SENC delivery in S-100 would not be less secure than it is now with S-57, as commercial companies' data security processes will be just as secure as those of a hydrographic office, and because they have direct communications with vessels for transferring charts, updates and other data, their systems and software must be totally secure.

Q) With regard to the interoperability of S-101 and S-104 discussed during previous sessions, how far does S-98 go in providing answers?

- *Hannu Peiponen (Furuno Finland)* suggested that when IHO assists IMO in amending MSC.232(82), the new wording will be generic in nature, but specific enough to permit tidal/water level adjustment based on IHO standards, and stated his assumption that the methods on how this should be done (test data sets, screen samples etc.) will be contained in S-164.
- *Julia Powell (NOAA)* agreed that the first step is to identify the specific wording in the IMO performance standards that led to the IHO forbidding tidal adjustments in S-52, and then amending that wording to ensure it will allow for tidal adjustment in future. Today we have the ability and data to properly and safely perform a tidal adjustment on an ENC, and the IHO community has agreed that this is one of the key selling aspects of S-100, and is currently working on the content of S-100 and S-98 to ensure that tidal adjustment is permitted.

Session 5: Conclusions

This section outlines the conclusions reached during the final session of Workshop, based on the outcome of the discussions held during the earlier sessions.

Functionality of S-100 ECDIS

- In order to differentiate it from “legacy ECDIS” and to deliver its full benefits, S-100 ECDIS should be capable of loading and using multiple S-100 data products, provided the associated Product Specifications are mature and the data is available.
- It would be beneficial for S-100 ECDIS to support data streaming.

Dual-Fuel ECDIS

- Dual-Fuel ECDIS should not be seen as an interim step in the transition to S-100 ECDIS; instead a Dual Fuel ECDIS should be understood to refer to a fully-functional S-100 ECDIS that is also capable of loading and using S-57 ENCs.
- CIRM members should be actively participating in the work of the IHO standards community to further develop the Dual-Fuel ECDIS concept, contributing their knowledge and expertise to the process.

Timelines for standardisation work

- The IMO’s work to revise MSC.232(82) is scheduled to be completed in 2023, but the entry-into-force date for carriage of S-100 ECDIS remains unknown (at the time of writing).
- Completion of S-98 (interoperability specification) and S-164 (test data set) are critical to the success of S-100 ECDIS; IHO should publish timelines for finalisation of these standards.
- A considerable amount of work will be required to revise IEC 61174 to support S-100 ECDIS, and a PWI should be established within IEC TC 80 to begin the process.

Implementation

- The shipboard component of S-100 ECDIS should ideally be introduced as a single technical implementation, as opposed to implementing across multiple steps. This should at least be accomplished at the conceptual level - i.e. the S-100 ECDIS operates as a “plug and play” system, where S-100 data products can be integrated once available, instead of requiring another implementation.

Topics for further discussion

Functionality of S-100 ECDIS

- Further discussion is needed on which specific S-100 data products it should be mandatory for the initial S-100 ECDIS to support.

SENC delivery

- The concept of SENC delivery in S-100 ECDIS requires further discussion.



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