

Paper for Consideration by S-100 WG**Norwegian S-102 testbed**

Submitted by:	PRIMAR
Executive Summary:	Norwegian S-102 test bed update
Related Documents:	S-102 IHO Bathymetric Surface Product Specification.
Related Projects:	

Introduction / Background

PRIMAR initiated the project Pilot test S-102 in 2013. Together with partners from different places in the maritime data supply and data use chain, the goal was to test production, distribution and end user import and use of S-102 data as an auxiliary product to be used together with ENC information to facilitate safe navigation and to support various maritime operations. Furthermore the project intended to identify improvements to existing version of the relevant IHO standard, and to find user effective solutions for distribution, reception and implementation of S-102 product(s).

In 2017 PRIMAR and its partners has been granted national funding to develop a demonstrator for distribution and use of bathymetry data (S-102) in an operational environment.

Partners participating in this project are Electronic Chart Centre, Kongsberg Digital, Norwegian hydrographic Service, Norwegian Coastal Administration and the Norwegian Armed Forces.

Analysis/Discussion

The maritime data supply and data use chain stretches from data production to the end use of the actual product. As the standard separate between primary and secondary purposes, we believe there is end user demand for these bathymetry data both for navigational and other purposes. The topics data production, distribution, validation, end use and display will be further discussed.

Data production

Norwegian Hydrographic Service started test production of S-102 data using Caris software in 2014. Designated areas of special interest to Norwegian pilots were identified by the Norwegian Coastal Administration and chosen for test production. Further on, areas of interest for the Norwegian Armed Forces and the Norwegian coastguard were identified. This has resulted in test data being produced from different parts of Norway. In addition some test data has also been produced in Finland. Recently it was confirmed that Sweden, having participated as observer since the projects early stage, soon also will produce test data.

During the test production it has been created several different grid resolutions (in meters): 1x1, 5x5, 25x25 and 50x50. A difference in resolution for the same area could serve different users with different needs. One of the future challenges will be to define acceptable grid resolutions based on end user preferences and take into consideration the size of the dataset.

Different gridding options, such as TPU Weighted Mean, basic weighted mean, shoalest depth and shoalest depth true position has been evaluated and considered. The option inverse distance weighting was chosen as preferred gridding algorithm. Producers express concern for missing guidance in the standard on this topic.

Recently, it has been decided to create test data according to Caris multivariable resolution concept, where one product contains areas of different grid resolution.

Distribution

PRIMAR is developing a service for distribution of bathymetry data, and aim for expanding the PRIMAR ENC service with upload, validation, viewing, distribution, sales and customer support. It will be possible for producers to import data to PRIMAR GDS. Quality checks will be implemented and run automatically during upload of data. Metadata will be extracted to create an interface for distributors to find data in PRIMAR Chart Catalogue. As main activities in the current phase of the project PRIMAR will:

- Develop a solution for distribution based on area, resolution and projection.
- Investigate a possible solution for seamless calculation, extraction and distribution of vectorised depth contours in area and depth defined by the end user/end user system.
- Consider downloaded data volume/large data amounts up against the use value.
- Develop protocols and format of the service to be as effective and user friendly as possible for the end user system integration.
- Explore possible additional services for reception and distribution.

PRIMAR believe the work being done on S-102 will help the RENC preparing for the future S-101 handling and distribution. This project will develop methods and solutions that can be reused for later implementation of S-100 derived product solutions.

Validation

As for existing S-57 and future S-101 data, it is important to create validation checks and check routines to ensure acceptable quality is reached also for S-102 data. Therefore PRIMAR has identified and implemented several validation checks in the PRIMAR GDS S-102 test environment. Examples of validation checks implemented or in the process of being implemented:

- Error: Coordinate values do not define a proper bounding box.
- Error: Grid corner coordinates does not match grid size and resolution.
- Error: Incorrect definition of datum or parameters.
- Error: Inconsistency between definition of metadata dimension size and actual dataset dimension
- Error: Incorrectly formatted filename extension.
- Error: Incorrectly formatted filename
- Error: Invalid character in filename.
- Error: Invalid filename
- Error: Metadata minimumValue is not corresponding with dataset minimum depth value
- Warning: <Filename> greater than size limit 10MB.

As the work progresses, more validation checks will be identified and implemented. These checks could, if considered expedient, form the basis of a future S-102 validation check annex.

End use and display

PRIMAR is developing a web based S-102 viewer to use in OGC Web Map Service (WMS) for computers/tablets and phones. At a later stage a solution for OGC Web Chart Service (WCS) will be developed. The current PRIMAR WMS service provided will probably be expanded, so that it can deliver WMS and WCS for bathymetry through an aggregated service across national borders.

Hopefully there will be more innovative solutions developed like presenting an available water column by integrating tidal data or like calculation of a dynamic "under keel clearance" functionality and presentation.

Kongsberg Digital will develop an S-102 testviewer. The first phase will implement basic functionalities:

- Display different map-related data in one common picture - as a minimum, include ENC («north up»), bathymetry, terrain and orthophoto.

- Turn on and off different layers or types of map data.
- Change the way the different data types are visualized (for instance choosing between projecting the sea chart onto the bathymetry or projecting it onto a plane at the sea surface).
- Navigate; move around in this common picture.
- Display compass.
- (Measure distances, horizontal and vertical).
- (Measure depth at cursor).

Later phases could offer solutions tailored to handle more specific functionality. The use of bathymetric data could expand beyond strictly the navigation purpose, and the data could be used to create services for:

- Meeting places for vessels.
- Anchoring.
- Area planning for ship tunnel construction.
- Vessel traffic services.
- Maintenance and inspection of aids to navigation.
- Simulated ship.
- Dynamic sea surface, coloring, safe envelope for navigation.
- Hull description.

Improvements and suggestions.

During the work on this project several issues has arisen that could improve the S-102 standard. These issues are discussed further in an additional paper (*PRIMAR S-102 Improvements.pdf*) addressed to the S-102 subWG.

Conclusions

Validation tests are being developed that could be used as part of a validation test annex in the future. The work being done on S-102 test viewer could provide relevant interoperability information for ENC and S-102. The work on one specific S-100 derived product may result in information discovered and solutions created that could be beneficial for future work on other S-100 products.

Recommendations

PRIMAR recommend that IHO continue supporting the work on improving the IHO Bathymetric Surface Product Specification.

Action Required of S-100 WG

The S-100 WG is invited to:

Note this paper and encourage further work to be done in the S-102 subWG.