

Canadian Hydrographic Conference 2010

Introducing bathymetric ENCs

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INTRODUCTION

Electronic Navigational Charts (ENCs) have been introduced more than a decade ago. ENC coverage had been an issue for a long time. However, meanwhile the situation has considerably improved. ENCs are being compiled for use in ECDIS in the first place, and they are very suitable for sailing from one port to another. Yet they are not compiled for navigation in confined waters.

BACKGROUND

Today ENCs are not only used by type approved ECDIS but also by so-called ECS (Electronic Chart Systems) that are not meant to meet carriage requirement regulations, but serve as an optional additional device for navigation. In many cases ECS assistance is used for navigation in confined waters (e.g. Portable Pilot Units). Moreover, there are dedicated systems available for high precision operations (conveyance of huge ships in narrow waters, docking operations).

To apply an ECS system for high precision navigation the most accurate positioning systems (DGPS, RTK) must be used. And, very important, the navigational charts must contain high density depth information that has been retrieved from the latest hydrographic survey data. Usually ENCs do not contain high density bathymetry (see image 1). In fairways only the maintained depth is indicated. The navigator cannot see if there are areas within the fairway or next to it that are deeper and could be used in a situation of giving way to other vessels. A more detailed picture of the bathymetric conditions could also help the mariner to better estimate the ship's behaviour (e.g. banking effects).

The existing standards for ENCs do not prevent the incorporation of high density bathymetry. However, one must keep in mind that depth information that is provided with great detail changes frequently. Under certain conditions its validity is rather short-lived, and a new update is required very soon. This not only requires frequent updates but also fast ones (i.e. as soon after the survey campaign as possible). This creates a conflict with the existing ENC distribution procedures.

THE bENC CONCEPT

The bathymetric ENC (bENC) is a new S-57 based chart product for display in Electronic Chart Systems (ECS). Ideally the bENC content is based on the latest hydrographic surveys (e.g. a bENC that is produced today integrates source data that was collected yesterday). bENCs contain no other information but high density bathymetry and the relevant metadata. Typically a bENC contains S-57 feature objects of types depth contour, spot soundings, depth areas, and some meta objects but no other objects representing nautical information. Hence buoys, lights, restricted areas, etc. are not encoded in bENCs. By no means are bENCs meant to replace ENCs. They are used as a bathymetric complement and they add bathymetric detail to regular ENCs that contain very generic depth information only. This is why bENCs are always displayed in combination with ENCs or Inland ENCs

(unless they are used for other purposes than navigation). As depicted in image 2 the features of a bENC can be displayed by means of the same symbolization rules that are used for ENC's. Image 3 shows the combined chart image after the bENC has been loaded along with the existing ENC of the area.

PRODUCTION PROCESS AND DISPLAY

Hydrographic survey data is processed in many ways until a validated dataset which is free of any systematic errors or blunders is made available. Such data is also used for the production process of bENC's. Hydrographic processing packages can be used to generate depth contour lines and extract selected soundings from the validated source data. Then the data is exported to S-57 while contour lines and soundings are encoded according to the S-57 object catalogue. The preliminary conversion result is shown in image 4. The areas that are between contour lines or enclosed by contour lines are encoded as depth areas and attributed accordingly (image 5). For each individual bENC all kinds of meta-information is provided and encoded. Meta-information is data about data and in this case it comprises the dataset name, edition number, producer id, compilation scale, data quality, etc. The production process can be automated to a great extent with minimum user interaction.

A great advantage of the bENC approach over the integration of high density data into regular ENC's is the fact that both products (bENC's and ENC's) can be produced independently. There is no harmonization required – not even if there are different producers for bENC's and ENC's of the same geographic area. Authorities that have an interest to provide their bathymetric data in S-57 format do not have to get involved into full-blown ENC production at all. For them it is sufficient to produce bENC's that are automatically merged with the ENC's (produced by the Hydrographic Office) when loaded into the chart display of the navigation software.

Once bENC's have passed quality assurance checks they can be distributed. After having been installed on the ECS systems they can be used to complement the chart display. They can be switched on and off, and they react to the ECS display settings and filters just like regular ENC's. Due to the fact that bENC's may contain very dense contours (e.g. at decimetre level) they might cause clutter on the screen. Therefore it is recommended to use the same existing filter methods (SCAMIN setting, Display Categories) that are used for the presentation of ENC's (see image 6). However, deliberately no rules for the presentation of bENC data have been established. The reason is that the display should be flexible and the bENC presentation should allow to meet any specific requirements of the individual end-user application.

PRODUCERS AND USERS

The potential producers of bENC's are organizations that are in charge of ensuring navigational safety of the waterways (Waterway Authorities, Port Authorities, Hydrographic Offices). To fulfil this task hydrographic surveys must be conducted on a regular basis. Hence the data required for the production of bENC's is available already. The integration of high density depth information according to the bENC approach is a simple a straightforward conversion process rather than an elaborate cartographic task.

Among the potential users of bENC data are the pilots. Many of whom use PPU equipment already. The additional use of bENCs now offers to transfer the latest depth information onto the navigation display. VTMS operators could benefit from the use of bENCs as well. With the latest bathymetric detail on the screen they have additional valuable information for decision support. Marine simulators are often used for training of the bridge personnel. Many of them use the depth information of ENC's as one reference (of many) for the simulation of the ship's behaviour. Since regular ENC's do not contain high density bathymetry the use of bENCs could help to draw a more realistic picture of the vessel's passage through the water.

PROJECTS

There are a few projects which are related to bENCs. Since 2008 regular production of bathymetric ENC's for the German river Elbe (70 nm Cuxhaven to Hamburg) has been established. About two new editions are released per week. Today the production is conducted by the competent Waterway Authority exclusively. In the past the Elbe pilots and the German Hydrographic Office were involved as well and provided valuable input. SevenCs introduced the concept and provided assistance regarding the implementation of the production workflow. In 2006 the EU project EFFORTS (Effective Operations in Ports) was launched and finished in 2009. Hamburg Port Authority (HPA) was the leader of the so-called sub-project Port ECDIS. In the framework of these activities HPA produced bENCs of the port area which were then integrated into the Port ECDIS dataset.

bENCs AND S-100

According to the S-100 information paper the "bathy ENC" will be supported. An easy transition from S-57 bENCs to S-100 bENCs is expected. The procedures are similar to the transition from S-57 based ENC's to S-100 (S-101). The new S-100 based ENC Product Specification is under development already.

CONCLUSIONS

So far the bENC concept has proven to be a perfect method for the integration of high density bathymetry into electronic charts. The production process can be automated to a great extent. It is simple and straightforward, and the potential producers do not necessarily have to get involved in complete ENC production. ECS systems using bENCs gain an additional value especially when navigating through confined waters. The concept is future oriented and can be adjusted to comply with the new S-100 standard.

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Biography (Author)

Friedhelm Moggert-Kägeler holds a degree in Geodesy and Hydrography. He has been working at SevenCs since 1998. Over the years he has acquired specialised knowledge and expertise in the domain of ECDIS/ENC related matters. Today he works as Product Manager of the SevenCs ENC Production Tools.