Relationship of Marine Information Overlays (MIOs) to Current/Future IHO Standards[1]

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Background

Marine Information <u>Overlays</u>[2] (MIOs) consist of standardized collections of supplementary information to be used with an Electronic Chart Display and Information System (ECDIS) that are not Electronic Navigational Chart (ENC) objects or specified navigational elements or parameters. Supplementary, in this context means additional, non-mandatory information not already covered by existing International Maritime Organization (IMO), International Hydrographic Organization (IHO), and International Electrotechnical Commission (IEC) standards or specifications. Examples of MIOs include ice coverage, tide/water level, current flow, and meteorological, oceanographic, and marine habitats. Depending on the navigational situation or current task-at-hand, the provision and use of MIOs (for example, ice coverage or weather conditions) can be crucial in terms of improving both the safety and efficiency of maritime navigation, as well as ensuring the protection of the marine environment, such as in coral reef habitats.

As defined in the revised IMO Performance Standards for ECDIS,[3] an
> *Electronic Navigational Chart (ENC) means the database, standardized as to content, structure and format, issued for use with ECDIS by or on the authority of government authorized hydrographic office or other relevant government institution, and conform to IHO standards. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation.*

In terms of being "supplementary information", MIOs are not contained within nor are they an integral part of an ENC. Rather, MIOs are separate, supplementary information that are displayed in conjunction with the overall System ENC[4] (SENC). This is similar in concept to adding radar and AIS information to an ECDIS display, and is covered in the IMO ECDIS Performance Standards as follows: "*Radar information or other navigational information may be*

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[1] An HGMIO Information Paper agreed at the 4th HGMIO Meeting, Durham, NH, USA 22-23 May 2007, and endorsed by IHO CHRIS19, Rotterdam, The Netherlands, 5-9 November 2007.

[2] Name change of Marine Information "~~Objects~~ → "**Overlays**" was agreed at the 4th HGMIO Meeting, 22-23 May 2007.

[3] IMO Resolution MSC 232(82), adopted 5 December 2006.

[4] System ENC (SENC) is the integrated data set held in an ECDIS' internal computing format resulting from the transformation of the ENC together with any other supplemental information.

added to the ECDIS display. However, it should not degrade the SENC information, and should be clearly distinguishable from the SENC information".

The IMO Performance Standards for ECDIS require chart data to conform to IHO S-57 data standards, and also that IHO colours and symbols be used to represent the System ENC (SENC) information. While the current edition of IHO S-57 (Edition 3.1) contains an ENC Product Specification, it does not specify the content or format for supplemental information (such as MIOs). Similarly, neither the current IHO Colours and Symbols Specifications for ECDIS (IHO S-52, Appendix 2) nor IEC Publication 61174 (*ECDIS - Operational and Performance Requirements, Method of Testing and Required Test Results)* specify how any supplemental information should be displayed.

ENC Product Specification

As defined in IHO S-57 (Edition 3.1), Appendix B.1, the ENC Product Specification is:
> *The set of specifications intended to enable Hydrographic Offices to produce a consistent ENC, and manufacturers to use that data efficiently in an ECDIS that satisfies the IMO Performance Standards for ECDIS. An ENC must be produced in accordance with the rules defined in this Specification and must be encoded using the rules described in Appendix B1, Annex A "Use of the Object Catalogue for ENC.*

In an effort to assist in the consistent and uniform production of ENC data, IHO S-57 (Ed. 3.1) and the associated ENC Product Specification have been "frozen" by IHO since November 2000. However, during 2006, IHO found it necessary to make some adjustments/extensions to IHO S-57 to address recent IMO requirements that included the designation of Particularly Sensitive Sea Areas (PSSA) and Environmentally Sensitive Sea Areas (ESSA) on a paper nautical charts and ENCs. [5]

Since a chart-related MIO is intended to be used in an ECDIS or ECS in conjunction with an existing ENC, it should conform – as much as is practicable – to the ENC Product Specification. This includes parameters such as navigational purpose (compilation scale), cell boundary, topology, feature object identifiers, meta objects, mandatory (required) and supplemental attributes, horizontal or vertical datums, units, etc. However, there are some specific requirements pertaining to the production of consistent and uniform MIO data that would be best met by developing a general content specification for all MIOs. This would also include the use of time-varying objects that contain dynamic/temporal information (tides, water levels, current flow, wind, waves, etc.), since these are not included in ENCs.

General Content Specification for MIOs

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[5] "Enhancements Required to Encode S-57 3.1.1 ENC Data" (S-57 Supplement No.1), IHB, Monaco, January 2007. [www.iho.shom.fr]

Since many types of MIOs are possible, there is a benefit in having them conform to a general content specification. While such a specification should comply as much as possible with the S-57 ENC Product Specification, it should also take into account the strategy being used by NATO to define Additional Military Layers (AMLs). AMLs are similar to MIOs. They contain supplementary layers of defense-related information for use in NATO Warship ECDIS.

More specifically, the development of a General Content Specification for MIOs has followed the approach taken by the UK Hydrographic Office in its recent consolidation of the various Product Specifications previously developed for specific types of AMLs. So far, the NATO AML for Routes Areas and Limits (RAL) appears to be most applicable to MIOs. The main benefit of this approach is that ENC Software manufacturers (such as, *CARIS, SevenCs, and dKart*) will not have to develop new software tools to deal with MIOs. Software that is currently used to produce AMLs will only require minor modification to produce MIOs. Furthermore, ECDIS and ECS manufacturers will be able to interpret and display MIOs in a similar way to what is already being done for AML and ENC data. As a result, a General Content Specification for MIOs (Edition 1.0), dated 24 May 2007 was finalized at the 4th Meeting of HGMIO in Durham, New Hampshire, USA on 22-23 May 2007.

Development of a MIO Encoding Guide

Although the IHO S-57 ENC Product Specification provides specific guidance (rules) on how ENC data is to be encoded, additional information is needed related to encoding S-57 objects, attributes and attribute values that are in the IHO S-57 Object Catalogue, but not used in the ENC. This will also be the case for newly-created S-57 object classes, attributes and attribute values that are registered on the *Open ECDIS Forum* (OEF)[6] from time to time or in the near future on the IHO Registry in conjunction with the new IHO S-100 standard.[7] This will be similar to the strategy that is used by the European – North American – Russian Federations Inland ENC Harmonization Group (IEHG) for additional ENC object classes, attributes and attribute values not contained in the S-57 Object Catalogue.

In addition, IEHG has produced its own "Inland ENC Encoding Guide" in order to achieve consistent encoding of S-57 objects/attributes for real-world inland/river requirements. For all S-57 object classes, attributes, and attribute values that are required to produce an Inland ENC, the "Inland ENC Encoding Guide":
1. Provides a basis for its creation
2. Describes its relationship to the real-world entity
3. Provides criteria for its proper use
4. Gives specific encoding examples

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[6] www.openecdis.org

[7] IHO Geospatial Standard for Hydrographic Data (IHO S-100). An information paper about IHO S-100 is posted on the IHO website: www.iho.shom.fr

A similar approach will be undertaken to develop a "MIO Encoding Guide."

The Development of a "MIO Encoding Guide" was discussed at the 4th HGMIO Meeting. Currently, a prototype version is being produced in conjunction with a MIO Testbed Project concentrating on coral reef habitats and Marine Protected Areas (MPAs) in the Florida Keys National Marine Sanctuary. The primary purpose of having an "MIO Encoding Guide" is to provide detailed guidance on what is required to produce a specific type of MIO in a consistent and uniform manner -- anywhere in the world. An additional benefit of providing an "Encoding Guide" – whether it is for Inland ENCs or MIOs is that these will be living documents that will accommodate change unlike the IHO S-57 ENC Product Specification which effectively "frozen" for significant periods of time.

Framework for International MIO Specifications

A document on *Recommended Procedures for the Development of Marine Information Overlays (MIOs)* was initially developed in December 2004, and approved at the 17th IHO CHRIS Meeting in September 2005. An updated version of these procedures (Edition 1.1, 24 May 2007) that contains minor wording changes (e.g., ~~objects~~ → overlays) was prepared following the HGMIO4 meeting.

The procedures for MIO development provide guidance on:
    - How a "competent organization" should identify MIO-related requirements
    - Information content for a MIO category
    - Development of new S-57 objects and attributes
    - Appropriate colours and symbols, based on IHO S-52
    - Test and evaluation
    - Production/dissemination of MIO data
    - Potential regulatory requirements on proper use

The overall framework for achieving internationally-accepted MIO specifications includes several objectives:
    - Alignment with IHO S-57 Edition 3.1/3.1.1, where applicable.
    - Development of a harmonized MIO Encoding Guide
    - Establishment of a central register for MIO object classes, attributes, and attribute values.
    - Use of the Open ECDIS Forum (www.openecdis.org) as a means for communication and publication.
    - Alignment with the forthcoming edition of IHO S-100.

Alignment with Forthcoming IHO S-100

IHO S-57 edition 3.1 is used almost exclusively for encoding Electronic Navigational Charts (ENCs). There is now a need for a more flexible contemporary standard that can be used for a wider variety of uses involving hydrographic and other types of geospatial data. Work is ongoing within IHO to replace the current *Transfer Standard for Digital Hydrographic Data* (S-57) with a more modern *IHO Geospatial Standard for Hydrographic Data* (S-100).

The primary goal for S-100 is to support a greater variety of hydrographic-related digital data sources, products, and customers. This includes the use of matrix and raster data, 3-D and time-varying data (x, y, z, and time), and new applications that go beyond the scope of traditional hydrography (e.g., high-density bathymetry, seafloor classification, marine GIS). It will also enable the use of web-based services for acquiring, processing, analyzing, accessing, and presenting data. S-100 will not be an incremental revision of S-57 3.1. S-100 will be an entirely new standard that includes both additional content and support of a new data exchange format.

Due to the worldwide prominence of ISO standards, IHO S-100 will be based on the ISO 19100 series of geographic standards. This requires a new framework, and the use of new/revised terms compared to S-57. IHO plans to release a first draft of S-100 in early 2008. Meanwhile, S-57 edition 3.1/3.1.1 will continue to be used for ENCs for many years to come -- even after S-100 has been released. Since current ECDIS equipment are required to use ENC data conforming to the S-57 ENC Product Specification, in the near term MIOs will continue to be based S-57 . However, similar to AMLs, MIOs will be independent from the ENC Product Specification even though they will be used with S-57 based ENCs.

In conjunction with the development of a future ENC Product Specification (IHO S-101), a determination will be made on how to produce MIOs suitable for use with S-100 based ENCs. It is expected there will be several benefits. Using the ISO 19100 standards will help to solve existing and future interoperability issues related to broader geo-spatial applications. Quite likely, MIOs will play an important role in the emerging Spatial Data Infrastructure (SDI) arena. In addition, S-100 will be far more capable of supporting new types of MIO products requiring imagery and gridded data.