

19th CHRIS Meeting
Rotterdam, Netherlands, 5-9 November 2007

Report of IHO-IEC Harmonization Group on Marine Information Overlays (HGMIO)

Submitted by:	Lee Alexander, University of New Hampshire (Chair, HGMIO)
Executive Summary:	This report summarizes the activities of HGMIO during the period of 16 September 2006 – 20 October 2007.
Actions to be taken	Note the current activities of HGMIO; approve the General Content Specification for MIOs (Annex A); endorse the HGMIO paper Relationship of MIOs to Current/Future IHO Standards; confirm the need to establish a MIO Register for S-57 related data.
Related Documents:	IHO S-57, IHO S-52, and future S-100
Related Projects:	n/a

Chair: Dr. Lee Alexander, University of New Hampshire
 Vice-Chair: Cameron McLeay, CARIS
 Secretary: Michel Huet, IHB

Introduction

Marine Information **Overlays**¹ (MIOs) consist of chart- and navigation-related information that supplements the minimum information required by ECDIS. As it pertains to the use of Electronic Navigational Chart (ENC) data, MIOs are additional, non-mandatory information not already covered by existing IMO, IHO, or IEC standards. Currently, this includes ice coverage, tide/water level, current flow, meteorological, oceanographic, and marine habitats/protected areas. The supplemental information is primarily additional S-57 objects/attributes but could also be imagery, graphics, or gridded data. In 2001, a Harmonization Group on MIOs (HGMIO) was established between IHO and IEC to recommend additional data and display specifications that may be incorporated into future editions of IHO and IEC standards. This report provides a brief update on HGMIO-related activities.

Current MIO Standards Development

Development Procedures

Approved at CHRIS17 in September 2005, an updated version of *Recommended Procedures for the Development MIOs* (Edition 1.1, 24 May 2007) containing minor wording changes (e.g., **objects** → **overlays**) was issued following HGMIO4.

[http://www.iho.int/COMMITTEES/HGMIO/MIO_Procedure_Ed1.1.pdf]

These procedures provide guidance on:

- How a “competent organization” should identify MIO-related requirements.
- Information content for a MIO category.

¹ At the 4th Meeting of HGMIO, it was agreed that a better term for “objects” in the context of Marine Information was “overlays.”

- 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.

As described in the *Recommended Development Procedures*, the overall framework for achieving internationally-accepted MIO specifications includes:

- 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.

General Content Specification

Since many types of MIOs are possible, there is a benefit in having individual product specifications be based on an overall content specification. Complying as much as possible with the S-57 ENC Product Specification, the *General Content Specification* also takes into account the approach taken by the UK Hydrographic Office in its recent consolidation of the various product specifications previously developed for specific types of Additional Military Layers (AMLs). The benefit of this approach is that ENC Software manufacturers (e.g., *CARIS*, *SevenCs*, and *dKart*) will not have to develop new software tools to deal with MIOs. Software that is currently used to produce ENCs and 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 being done for AML and ENC data. A *General Content Specification for MIOs* (Edition 1.0, 24 May 2007) was finalized at HGMIO4 on 23 May 2007. [http://www.iho.int/COMMITTEES/HGMIO/General_Content_Spec_for_MIOs_Ed1.0.pdf]. Since that time, most companies who provide S-57 data production tools (e.g., for ENCs, AMLs, and MIOs) have indicated their intention to use the General Content Specification. This includes *CARIS*, *ESRI*, *Jeppesen Marine* (*C-Map* and *DeKart*) and *SevenCs*. In addition, other companies involved in the production or use of AMLs and MIOs also believe the General Content Specification to be a pragmatic approach to achieve consistency and uniformity.

Product Specifications

a) On 1 May 2007, a prototype MIO Product Specification for Coral Reef Habitats and Marine Protected Areas (MPAs) was completed by UNH & *CARIS*. Containing information specific to the Florida Keys National Marine Sanctuary (USA), it described the minimum content required to produce supplementary MIO layers for a defined geographic area in which ENC coverage exists. This example of a specific MIO Product Specification based on the *General Content Specification* was introduced and discussed at HGMIO 4.

Two different types of MIO layers would be produced:

- 1) coral reef habitat delineation based on existing GIS data (i.e., benthic habitats)
- 2) regulatory zones/areas based on International Conservation Union (IUCN) and NOAA Functional MPA classification systems.

The MIOs are comprised of both existing and new S-57 objects, attributes and attribute values. A testbed project to evaluate these MIOs with ECS equipment onboard three vessels that operate in the Florida Keys area is planned for Winter 2007/2008.

b) On 29 August 2007, the Office of Coast Survey, NOAA (USA) sent an e-mail to TSMAD members requesting a "courtesy review" of pre-submission to CHRIS for a MIO Product Specification for Marine Environmental Protection (MEP). The contents of the work package included a:

- MIO MEP Product Specification
- MEP Object Catalogue

- MEP Attribute Catalogue
- mini MEP Presentation Library to be used with S-52.

On 16 September 2007, a paper submitted by USA (NOAA) for CHRIS19 was posted on the IHO website [CHRIS19-08.1B]. It proposed: “*the preparation and adoption of an S-57 Product Specification for the exchange and use of marine environmental protection (MEP) hydrographic data.*” The submission included an Annex A (*Draft Marine Environmental Protection Specification* documents). Collectively, these documents contained the same level of information as that which was first sent to TSMAD. However, neither the CHRIS paper nor its Annex make any mention MIOs. This submission was not coordinated with HGMIO, nor does it follow the *Recommended Procedures for the Development MIOs* (Edition 1.1, 24 May 2007).

Future MIO Standards Development

Portrayal of MIOs

To date, HGMIO has not attempted to prescribe how MIOs should be displayed on ECDIS. The main reason is that MIOs are optional, non-mandatory information that supplement the minimum chart- and navigation-related information required for safety-of-navigation. Currently, most MIOs are simple points, lines, or areas. Although HGMIO has recommended that the portrayal/display of these types of MIOs be based on the colours and symbology contained in contained in printed publications, how MIOs are actually displayed has been left to OEMs and/or ECDIS users. However, based on what occurred at a recent Marine Electronic Highway (MEH) Project Steering Committee Meeting in Malaysia, IMO is increasing interested in establishing some standards for the display of MIO symbology.

As stated in Section 3(d) of the ToR, HGMIO requires tasking from CHRIS before starting to develop chart-related symbols for MIOs. However, HGMIO should also liaise with TSMAD and C&SMW beforehand. As such, a Memo was sent by the HGMIO Chair to be considered at the joint TSMAD-C&SMWG meeting in Stavanger in June 2007. The Memo listed four possible options:

- #1 - Do not standardize. Instead, ask OEMs to use C&S based on existing publications (e.g., M-44, INT Chart 1, S-52, ECDIS Chart 1, etc)
- #2 - Issue guidance on “portrayal” of MIOs in accordance with ISO 19117 and future IHO S-100.
- #3 - Recommended appropriate C&S for displaying MIOs using ‘.gif’ or ‘.pdf’ files (i.e., similar to *ECDIS Chart 1*).
- #4 - Propose “new” MIO C&S for possible inclusion into S-52, Appendix 2.

For option #3 and #4, a MIO Register for Portrayal could be established.

As contained in the Section 3.18 of the Minutes to CSMWG17, the Chair concluded:

MJ conclusion: MIO symbology is not considered as part of the permanent display on ECDIS. Instead, MIO objects and symbolization serves for planning tasks and general synopsis rather than for route monitoring and collision avoidance. HGMIO is therefore free to invent and propose useful symbology considering rules and guidance within S-52 App. 2. A period of consultation between HGMIO and CSMWG and practical testing of the usefulness of the proposed symbology should be followed by the registration of the resulting MIO symbology. In this registration process MIO symbols will NOT be added to the CSMWG/S-52 PresLib register which is currently under preparation under the IHO umbrella. Instead, HGMIO will have to build their own register for MIO-symbols within the IHO registry or an OEF register in the interim.

This guidance seems clear that there should be a registration process for MIOs symbology that HGMIO should establish. Further, that MIO symbols will not be added to the S-52 C&S Presentation Library.

Currently, a HGMIO Information Paper is under preparation that deals with the Portrayal/Display of MIOs. It will be based on the outcome of the CSMWG17 meeting, and a series of e-mails that were exchanged between the Chairs of CHRIS, TSMAD, CSMWG and HGMIO. It will also describe the MIO display-related requirements that are contained in IEC 62288 (CDV, August 2007) on the “*Presentation of Navigation-Related Information on Shipboard Displays.*” Once

completed, it will be circulated for review/comment by HGMIO members prior to being formally submitted to IHO CHRIS and IEC TC80.

Encoding Guide

Similar to what is being used for Inland ENC's, the Development of a "MIO Encoding Guide" was discussed at the 4th HGMIO Meeting. To date, a prototype version was produced in conjunction with a planned MIO Testbed Project dealing with coral reef habitats and Marine Protected Areas (MPAs) in the Florida Keys National Marine Sanctuary (USA). 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 using an "Encoding Guide" -- both for Inland ENC's and MIOs -- is that it will be a living document that can accommodate change. This is not the case for the current IHO S-57 ENC Product Specification which is "frozen".

Since current ECDIS equipment are required to use ENC data conforming to the S-57 ENC Product Specification, MIOs will continue to be produced based S-57 3.1/3.1.1. However, following the adoption of the new IHO Geospatial Standard for Hydrographic Data (S-100), -- and any future ENC Product Specification based on S-100, a determination will be made on how to produce MIOs suitable for use with both S-57 and S-100 based ENC's.

MIO Register

At present, there is no means to register MIO standards associated with:

- new S-57 objects, attributes, and attribute values
- individual product specifications
- portrayal/display of MIO information

Both for S-57 and S-100 related data, there may eventually be a need for a MIO Register. Although this was discussed at HGMIO4, at that time there was not a strong consensus for the need to do so. However, two recent developments may cause the need to reconsider:

- 1) IMO Marine Electronic Highway Project (Straits of Malacca/Singapore)
- 2) Product Specification Marine Environmental Protection (MEP)

Current Status of MIO-related Activities

a. Sea Ice – Task Leader: John Falkingham (Ice Services Canada)

John Falkingham of the Canadian Ice Service, Environment Canada represented the IHO and HGMIO at the meeting of the World Meteorological Organization JCOMM Expert Team on Sea Ice (ETSI) in Geneva, March 28-31, 2007. The relevant items discussed were:

- ETSI as the competent authority for sea ice information in electronic navigation systems
- Appointment of an ETSI Task Group on Electronic Navigation Chart Information Objects (TG ENCIO) and a Sea Ice Register Manager.
- The *Ice Objects Catalogue* (Version 4.0) has been extensively reviewed and revised to ensure internal consistency, consistency with S-57 standards and compatibility with related sea ice standards. As such, it will become the basis for the Sea Ice Register as a part of the overall IHO Registry.
- The TG ENCIO and the Sea Ice Register Manager (Alice Soares, Ocean Affairs of WMO) will develop the appropriate documents to effectively implement and maintain the Ice Objects Catalogue as an IHO Register.

There is already an established set of colours and symbols for the Ice Objects, which is proposed as the initial set for the IHO Register. In collaboration with the HGMIO, users and ECS manufacturers, the TG ENCIO will revise these symbols as appropriate and necessary. The TG ENCIO will also work with these groups to develop a testing strategy, in accordance with the *Recommended Procedures for Development of MIOs*. Tentatively, there may be a limited testbed effort conducted in the Gulf of St. Lawrence – St. Lawrence River of Canada during Winter 2007-2008.

b. Meteorological - Task Leader: Michel Huet (IHB)

Object Classes and Attributes for Weather (Version 1.0) were first proposed by SevenCs in November 1999. However, only basic colours or symbols for these objects were developed. Liaison was established with a NATO group developing an Additional Military Layer (AML) on weather information with the aim to harmonize NATO and HGMIO developments. It is also hoped that this group and HGMIO can cooperate to develop appropriate S-57 objects/attributes and symbology for the display of weather information on ECDIS / WECDIS. Liaison with the World Meteorological Organization is also being sought.

c. Tides/Water Levels – Interim Task Leader: Lee Alexander (Univ. of NH)

In 2001, SevenCs developed a tide-simulation model for a “tide-aware” ENC. Prototype ENC data sets were produced for two ports (Singapore and Schelde/Vlissingen, Netherlands) based on one-meter depth areas. A simulated 10-meter tidal range was then applied, and the display modified based on time and ship’s safety contour (depth). Further enhancements included the establishment of designated tidal zones within the overall area.

Research continues at the University of New Hampshire and NOAA (USA) to develop dynamic tide and water level applications for the “Next Generation ENC” based on the development of a MIO layer containing both discrete tidal zones and water surface model that assigns predicted/real-time “z” values (e.g., height and time) to a gridded bathymetric dataset. There are plans to test both types with existing ECDIS and ECS equipment that are currently installed onboard government and commercial vessels.

d. Current Flow – Task Leader: [vacant]

In 1997, the Canadian Hydrographic Service, Quebec Region published an *Atlas of Tidal Currents for the St. Lawrence Estuary*, from Cap de Bon-Désir to Trois-Rivières. Based on an April 2004 meeting at the Maurice-Lamontagne Institute, Mont Joli, Quebec, there was interest to convert some of this data into S-57 objects that could be used with existing ENC data and ECDIS systems. Ideally, this would include the development of gridded chart data models that can be used with both tide and current flow information. Potentially, this may become part of the e-Navigation Testbed Project that will be conducted on the St. Lawrence River in Canada.

e. Oceanographic – Task Leader: Max van Norden (US Naval Oceanographic Office)

A Technical White Paper: *Oceanographic Object Attribution* was prepared by the U.S. Naval Oceanographic Office in June 2002. It summarized the activity and developments being undertaken in the field of oceanography that appear to be related to electronic charting. Several new oceanography object classes and attributes were proposed. Further work that that is needed includes:

- 1) Recommendations on oceanographic objects that should be addressed in an ECDIS.
- 2) Develop a suitable method for handling 3-D data in a 2-D environment.
- 3) How to relate climatological and real-time data.
- 4) Assign attributes and colour tables to oceanographic objects.
- 5) Investigate how oceanographic data should be used with other data sets without introducing clutter.
- 6) Produce a sample dataset of physical oceanographic objects for testing in an ECDIS.

f. Marine Environmental Protection – Task Leader: [vacant²]

The Office of Coast Survey, NOAA (USA) is conducting a pilot project in the Florida Keys National Marine Sanctuary to convert existing coral reef, marine protected areas (MPA), and other marine habitat information into MIOs that can be used with ECDIS and ECS equipment. NOAA and the Florida Dept. of Environmental Protection produced a CD-ROM of the *Benthic Habitats of the Florida Keys*. It contains colour imagery and GIS files that describe and show the location of shallow seafloor habitats, such as coral reefs. In support of this effort, CARIS prepared a report on how this benthic habitat mapping data (e.g.,

² The previous Task Leader withdrew from HGMIO on 23 May 2007 stating the need to focus more time/effort on TSMAD activities.

ArcView™ shapefiles) could be converted into S-57 feature objects using CARIS HOM ENC software tools. New S-57 objects, attributes and attribute values have been created both for coral reef habitats and for various marine protected areas (MPAs). A prototype Coral Reef/MPA MIO Product Specification has been completed. There are tentative plans to conduct at-sea trials 2008 in the Florida Keys using ECS equipment that have the capability to display ENC and RNCs with these Coral Reef/MPA MIO layers.

g. electronic Aids-to-Navigation Service Information (e-ANSI) – Task Leader: Michel Huet (IHB)

The International Association of Lighthouse Authorities (IALA) established a Working Group on electronic Aids-to-Navigation Information Service (e-ANCI) in 2004. The objective of e-ANSI is to provide real-time information to ships on the status of Aids-to-Navigation (AtoN) that are critical for the safety of navigation and the protection of the environment. It is planned that Automatic Identification Systems (AIS) will be used to broadcast the relevant e-ANSI information in an appropriate data format.

Based on the requirements defined at the June 2005 Workshop on International Standardization of e-ANSI Information on ECDIS (i.e., e-ANSI as a MIO), existing/new S-57 objects, attributes and attribute values were developed by Michel Huet (IHB) and Lee Alexander (UNH) in May 2007. The next steps include the possible establishment of an ANSI S-57 Object Register, and developing guidelines for suitable portrayal.

IMO Performance Standards for Display of Navigation-related Information

In December 2004, IMO adopted Performance Standards for the Presentation of Navigation-Related Information (MSC 19(79)). The purpose of this Performance Standard is to: *“supplement and in case of conflict, take priority over presentation requirements of the individual performance standards...”* (Sec. 1, Purpose). In turn, IEC Publication 62288 contains the methods of testing and required test results for equipment/systems that conform to this new IMO Performance Standard. The Committee Draft for Voting (CDV) version of IEC 62288 has been issued. Collectively, both performance standards (IMO and IEC) will affect how MIO information will be a component of an overall harmonized display of navigation-related information on ECDIS and other shipboard systems.

Next Meeting

The date/location of the next HGMIO meeting has not been planned. Most likely it will take place in late spring/summer 2008 in North America.

Action Required of CHRIS

1. Note the activities of HGMIO related to MIO standards development/implementation.
 2. Approve the *General Content Specification for MIOs*, Edition 1.1, 24 August 2007 (Annex A).
 3. Endorse the *Relationship of MIOs to Current/Future IHO Standards*, Version 4, 24 May 2007 (Annex B).
 4. Consider the need to establish a MIO Register for S-57 objects/attributes, product specifications, and portrayal.
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General Content Specification for Marine Information Overlays (MIOs)³

Edition 1.1⁴

28 August 2007

1.0 Introduction

Marine Information Overlays⁵ (MIOs) consist 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 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.

Since a chart-related MIO is intended to be used in ECDIS or ECS in conjunction with an existing ENC, it should conform – as much as practicable – to the IHO S-57 ENC Product Specification. This includes such criteria as navigational purpose (compilation scale), cell boundary, topology, feature object identifiers, meta objects, mandatory (required) and supplemental attributes, horizontal or vertical datums, units, etc.

There are many types of types of MIOs that could be produced. As such, there is a benefit of having them all be based on a single, general MIO Content Specification. Although it will conform as much as possible to the S-57 ENC Product Specification, it will also follow the approach used by NATO to develop various product specifications for Additional Military Layers (AMLs). Similar to MIOs, AMLs are supplementary layers of ‘military’ information that are used in conjunction with a NATO Warship ECDIS that uses IHO S-57 ENC data.

1.1 Scope

This General Content Specification defines the content and provides a description of the schema, accuracy, and data format for MIOs as a supplementary layer to be used with an IHO S-57 ENC. Unless otherwise specified, this content specification conforms – as much as practicable – to the IHO S-57 ENC Product Specification.

This general content specification is intended to enable electronic chart software manufacturers to produce MIOs in a similar manner as that used to produce ENCs. Given that there is close similarity, the commercial software tools that are also used to produce AMLs will only require minor modification to produce MIOs. Further, ECDIS and ECS manufacturers will be able to interpret and display MIOs similar to what is done currently for AML and ENC data. Although it has not been formally adopted by IHO or IEC, implementation of this MIO Content Specification is intended to ensure consistent and uniform MIO production, worldwide.

1.2 Contents of this Document

Similar to the approach used for the IHO S-57 ENC Product Specification, this MIO Content Specification is divided into the following sections:

1. Introduction

³ Finalized at the 4th Meeting of HGMIO in Durham, New Hampshire, USA on 22-23 May 2007.

⁴ Updates previous Edition 1.0 of 24 May 2007.

⁵ At the 4th Meeting of HGMIO, it was agreed that a better term for “objects” in the context of Marine Information was “overlays.”

2. General Information
3. Objects and Attributes
4. Cartographic Framework
5. Provision of Data
6. Application Profiles

1.3 References

IHO S-57 3.1 ENC Product Specification (Appendix B.1, Ed. 2.0)

AML Product Specifications

- Route, Areas and Limits (RAL), Ver 2.1
- Environment Seabed and Beach (ESB), Ver 2.1

IMO Performance Standards for ECDIS (IMO MSC.232(82)), December 2006

2. General Information

2.1 Navigational Purpose

MIO data is compiled for a variety of planning and operational purposes. The six (6) ENC Navigational purposes can be used. However, since MIO are often composed of non-scaled vector data (e.g., points, lines or areas), the navigational purpose code is usually “zero” (0).

2.2 Cells

An MIO dataset must fit within a rectangular cell defined by two meridians and two parallels. The coordinates of the borders of the cell are encoded in decimal degrees.

The area within the cell which contains data must be indicated by a meta object M_COVR with

CATCOV = 1. Any other area not containing data must be indicated by a meta object M_COVR with CATCOV = 2.

2.3 Topology

Similar to an ENC, MIO data is encoded using chain-node topology. However, arcs may be useful for some future applications.

3. Objects and Attributes

3.1 Feature object identifiers

Same as the ENC Product Specification.

3.2 Standard object classes and attributes

Unlike the tightly-defined ENC, there are no restrictions on using any of the existing S-57 objects/attributes contained in the IHO Object Catalogue (S-57 Appendix A). Further, there are an increasing number of new objects classes, attributes, and attribute values that were specifically created to meet new requirements or applications (e.g., inland/river navigation, ice coverage, coral reefs, marine protected areas, etc.). As such, any S-57 objects/attributes that are registered in IHO Feature Data Dictionary Registry can be used.

3.3 Permitted Objects

Unlike an ENC, there are no restrictions as to what S-57 objects are “permitted” or must be used to create a MIO. Additional S-57 objects, attributes and attribute values that were specifically developed for MIOs will be registered on the new IHO Feature Data Dictionary Registry⁶. Similar to an ENC, MIO object classes are a point, line, or area geometric primitive. Specific objects are specified in the individual MIO Product Specifications.

3.4 Meta objects

Same as the ENC Product Specification.

3.5 Geo and meta object attributes

3.5.1 Missing attribute values

Same as the ENC Product Specification.

3.5.2 Mandatory attributes

There are no mandatory attributes that must be used in this “Generic” MIO Product Specification. Detailed guidance on what attributes are mandatory for a specific object class is contained in the MIO Encoding Guide. Unlike the S-57 ENC Product Specification, the MIO Encoding Guide is intended to be a living document that can accommodate change.

3.5.3 Prohibited attributes

[Not applicable]

3.5.4 Numeric attribute values

Same as the ENC Product Specification.

3.5.5 Text attribute values

Same as the ENC Product Specification.

3.5.6 Hierarchy of meta data

If required, guidance on what attributes may supersede meta object attributes, or meta object attributes that supersede the data set subfields would be contained in the MIO Encoding Guide.

3.5.7 New attribute values in Edition 3.1.

[Not applicable]

3.5.8 MIO Object and Attribute Codes

⁶ The launch of the IHO Feature Data Dictionary Registry was announced by IHO on 26 July 2007 (see TSMAD Letter: 04/2007). The current webpage interface is http://195.217.61.120/ho_registry/. [Note: This is a temporary address which will eventually be replaced by an official IHO url]. Currently, there is no Register Manager specifically for MIOs. As such, S-57 objects/attributes or new S-100 features/attributes or will be registered under the Hydro Register.

New objects and attributes specifically developed for MIOs have been assigned codes that fall within 30,000 – 39,999. The following codes ranges apply to the various categories/sub-categories of MIO-related objects and attributes. These categories/sub-categories are also the same as those listed for **MIO Dataset Files** (see Section 5.6.3)

Range		MIO	Sub-category
30000 - 30099	A	Aids-to-navigation	(AtoN)
30100 - 30199	C	Current	flow
30200 - 30299	D	sailing	Directions
30300 - 30399	I	Ice	coverage
30400 - 30499	L	Logistics	
30500 - 30599	M	Marine environmental protection (coral reef, MPA)	
30600 - 30699	O	Oceanographic	
30700 - 30799	P	Pipelines/cables	
30800 - 30899	R	Rivers/Inland	Waterways
30900 - 30999	S	Security	
31000 - 31099	T	Tide/water	level
31100 - 31199	V	Viewpoint (as exists in AMLs)	

3.6 Cartographic objects

Similar to ENC's, cartographic object are not used.

3.7 Time-varying objects

MIOs can include the use of time-varying objects that contain dynamic/temporal information (tides, water levels, current flow, wind, waves, etc.).

3.8 Geometry

Same as the ENC Product Specification.

3.9 Relationships

Same as the ENC Product Specification.

3.10 Groups

All MIO objects are Group 2 objects.

3.11 Language and alphabet

Same as the ENC Product Specification.

4. Cartographic Framework

4.1 Horizontal datum

Same as an ENC (WGS 84).

4.2 Vertical and sounding datum

Same as the ENC Product Specification.

4.3 Projection

Same as an ENC, no projection is used. Coordinates are encoded geographical positions (latitude, longitude).

4.4 Units

Same as the ENC Product Specification. In addition, other units may be used.

5. Provision of data

5.1 Implementation

Same as the ENC Product Specification.

5.2 Compression

Same as the ENC Product Specification.

5.3 Security scheme

Similar to ENCs, a security scheme can be used (e.g., IHO S-63). However, this would be specified in the MIO Encoding Guide.

5.4 Exchange set

Same as the ENC Product Specification

5.5 Data sets

Same as the ENC Product Specification

5.6 File naming

5.6.1 README file

Same as ENC Product Specification.

5.6.2 Catalogue file

Same as ENC Product Specification.

5.6.3 Data set files

MIO data set files follow the same basic approach that is used for ENC and AML (8 characters). More specifically, they are named according to the following convention:

characters

2 Producer Code (from IHO S-62⁷ or OEF Producer Code Register⁸)

⁷ IHO S-62, Edition. 2.1 (June 2005) lists the codes for hydrographic agencies/organizations that produce ENC data.

- 2 MIO category (M + MIO sub-category as a capital letter)*
- 1 Scale band (most will be non-scale = zero)
- 3 Unique MIO number (a producer organization develops its own scheme)
- 8

* MIO sub-categories include:

- A Aids-to-navigation (AtoN)
- C Current flow
- D sailing Directions
- I Ice coverage
- L Logistics
- M Marine environmental protection
 - coral reef
 - Marine Protected Area (MPA)
- O Oceanographic
- P Pipelines/cables
- R Rivers/Inland Waterways**
- S Security
- T Tide/water level
- V Viewpoint (as exists in AMLs)
- W Weather/meteorological

Note: This listing is the same as the MIO object and attribute code ranges listed in Section 3.5.8. Further guidance on the applicability of these categories will be contained in the *MIO Encoding Guide*.

Example:

USMM0FL4 (a MIO for Florida Keys National Marine Sanctuary)

US Producer Code for **USA** NOAA

MM MIO category = **M** (for **MIO**) + **M** (for **Marine environmental protection**)

0 Scale band = zero (**0**)

FL4 **FL** (Florida) + **4** (National Marine Sanctuary)

8 The Open ECDIS Forum [www.openecd.org] currently provides a registration service for non-hydrographic agencies/private companies who produce S-57 data conforming to the ENC Product Specification. It is expected that this function will eventually be transferred to the IHO website.

5.6.4 Text and picture files

Same as the ENC Product Specification.

5.7 Updating

Same as the ENC Product Specification.

5.8 Media and Provision

MIOs can be provided on any standard type storage media (e.g., CD-ROM), or can be provided via Internet or telecommunication links (e.g., AIS).

5.9 Error detection

Same as the ENC Product Specification.

6. Application Profiles

6.1 General

Similar to an ENC, the application profiles for an MIO defines the structure and content of the catalogue file and date set file in an exchange set. In general, MIOs will be produced in the same manner as ENCs. However, there will some instances where it will need to be determined as to what is the best approach.

6.2 Catalogue file

6.2.1 Catalogue file structure

Same as ENC Product Specification.

6.2.2 Catalogue directory field

Same as the ENC Product Specification.

6.3 Application Profile

6.3.1 Base cell file structure

Same as the ENC Product Specification

6.3.2 Field Content

6.3.2.1 Dataset Identification Field – DSID

Tag	Subfield name	Use	Value	Comment
RCNM	Record name	M	{10}	= DS, binary
RCID	Record ID number	M		binary
EXPP	Exchange purpose	M	{1}	Data set is new, binary
INTU	Intended usage	M	{0} to {6}	Most will be Navigational Purpose = 0 (non-scaled)

DSNM	Dateset name	M		File name with extension excluding path, ASCII
EDTN	Edition number	M		Initial edition number is 1. Each new edition is increased by 1. ASCII
UPDN	Update number	M		n/a
IADT	Update application date	M		n/a
ISDT	Issue date	M		ASCII
STED	Edition no. of S-57	M	03.1	ASCII
PRSP	Product specification	P	{1}	Need a unique MIO Product Spec. No. [e.g., 60]
PSDM	Product specification description	M		MIO Categories are listed in Sec. 5.6.3
PRED	Product specification edition no.	M	1	ASCII
PROF	Application profile identification	M		= EN, binary
AGEN	Producer code	M		Obtain from ENC Producer Code List (S-62, or S-57 data producer organizations listed on Open ECDIS Forum (www.openecdis.org))
COMT	comment			ASCII

6.3.2.2 Data set Structure Information field - DSSI

Same as the ENC Product Specification.

6.3.2.3 Data set Parameter field – DSPM

Same as the ENC Product Specification.

6.3.2.4 Vector Record Identifier field –VRID

Same as the ENC Product Specification.

6.3.2.5 Vector Record Attribute field – ATTV

Same as the ENC Product Specification.

6.3.2.6 Vector Record Pointer field – VRPT

Same as the ENC Product Specification.

6.3.2.7 2-D Coordinate field – SG2D

Same as the ENC Product Specification

6.3.2.8 3-DCoordinate field (Sounding Array) – SG3D

[Not applicable]

6.3.2.9 Feature Record Identifier field – FRID

Same as the ENC Product Specification.

6.3.2.10 Feature Object Identifier field – FOID

Same as the ENC Product Specification.

6.3.2.11 Feature Record Attribute field – ATTF

Same as the ENC Product Specification.

6.3.2.12 Feature Record National Attribute field – NATF

Same as the ENC Product Specification.

6.3.2.13 Feature Record to Feature Object Pointer field – FFPT

Same as the ENC Product Specification.

6.3.2.14 Feature Record to Spatial Record Pointer field – FSPT

Same as the ENC Product Specification.

6.4 ER Application Profile

[Not applicable]

Relationship of Marine Information Overlays (MIOs) to Current/Future IHO Standards⁹Version 3¹⁰

24 May 2007

Background

Marine Information Overlays¹¹ (MIOs) consist 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 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. Current examples of MIOs include ice coverage, tide/water level, current flow, meteorological, oceanographic, and marine habitats. Depending on the navigational situation or current task-at-hand, the provision and use of MIOs (e.g., ice coverage, weather conditions, etc.) 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 (e.g., coral reef habitats).

As defined in the IMO Performance Standards for ECDIS, an *“Electronic Navigational Chart (ENC) means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. 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 ENC¹² (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, *“Radar information or other navigational information may be 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 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 (e.g., 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.

⁹ A HGMIO Information Paper that was discussed/agreed to at the 4th HGMIO Meeting, Durham, NH, USA 22-23 May 2007.

¹⁰ Replaces Version 2.1 of 9 February 2007.

¹¹ Name change of Marine Information “Objects” to “Overlays” was agreed at HGMIO4 Meeting, 22-23 May 2007.

¹² System ENC (SENC) is the data held in the ECDIS system resulting from the transformation of the ENC for appropriate use.

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 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 insure the consistent and uniform production of ENC data, IHO S-57 (Ed. 3.1) and associated ENC Product Specification have been "frozen" by IHO since November 2000. However, during 2006, IHO made some changes/extensions to IHO S-57 to deal with an IMO requirement to include the designation of Particularly Sensitive Sea Areas (PSSA) and Environmentally Sensitive Sea Areas (ESSA) on a paper nautical charts and ENCs.¹³

Since a chart-related MIO is intended to be used in ECDIS or ECS in conjunction with an existing ENC, it will conform – as much as practicable – to the ENC Product Specification. This includes such criteria as navigational purpose (compilation scale), cell boundary, topology, feature object identifiers, meta objects, mandatory (required) and supplemental attributes, horizontal or vertical datums, units, etc. Unlike for ENC data, MIOs are not restricted in the use of time-varying objects that contain dynamic/temporal information (tides, water levels, current flow, wind, waves, 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.

General Content Specification for MIOs

Since there many types of types of MIOs that can be produced, there is a benefit of having them conform to a general content specification. Although it will comply as much as possible with the S-57 ENC Product Specification, it will also follow the strategy used by NATO to produce Additional Military Layers (AMLs). Similar to MIOs, AMLs are supplementary layers of information that are used in conjunction with a NATO Warship ECDIS that uses IHO S-57 ENC data.

More specifically, the development of a General Content Specification for MIOs was similar to the approach recently taken by the UK Hydrographic Office in its consolidation of the various Product Specifications previously developed for specific types of AMLs. In particular, 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 (e.g., *CARIS*, *SevenCs*, and *dKart*) will not have to develop new software tools to deal with MIOs. What is currently used to produce AMLs will only require minor modification to produce MIOs. Further, ECDIS and ECS manufacturers will be able to interpret and display MIOs similar to what is done currently for AML and ENC data.

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 IHO S-57 provides specific guidance (rules) on how ENC data is to be encoded (i.e., the ENC Product Specification), additional information is needed related to encoding other S-57 objects, attributes and attribute

¹³ "Enhancements Required to Encode S-57 3.1.1 ENC Data" (S-57 Supplement No.1), IHB, Monaco, January 2007. [www.iho.shom.fr]

values that are currently contained in the IHO S-57 Object Catalogue. This will also be the case for newly-created S-57 objects, attributes and attribute values that may be registered on the Open ECDIS Forum (OEF) or on the future IHO Registry for IHO S-100 standard.¹⁴ Based on the strategy that was adopted by the Inland ENC Harmonization Group (IEHG) in order to produce new objects/attributes for real-world inland/river requirements not contained in the S-57 Object Catalogue, an “Inland ENC Encoding Guide” was produced.

For all 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

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 dealing with 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 using an “Encoding Guide” – both for Inland ENCs and MIOs -- is that it will be a living document that can accommodate change. This is not the case for the current IHO S-57 ENC Product Specification which is “frozen”.

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 by IHO CHRIS 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

¹⁴ 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

- Test and evaluation
- Production/dissemination of MIO data
- Potential regulatory requirements on proper use

The overall framework for internationally-accepted MIO specifications includes several components:

- IHO S-57 Edition 3.1/3.1.1, where applicable.
- Development of a harmonized MIO Encoding Guide
- 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.
- Align with the future edition of IHO S-100.

Alignment with Future IHO-100

Work is ongoing within IHO to replace the current *Transfer Standard for Digital Hydrographic Data (S-57)* with a new *IHO Geospatial Standard for Hydrographic Data (S-100)*. Since IHO S-57 3.0/3.1 is used almost exclusively for encoding Electronic Navigational Charts (ENCs), there is a need for a more robust standard to deal with changing requirements, customers and technology for hydrographic data.

The primary goal for S-100 is to support a greater variety of hydrographic-related digital data sources, products, and customers. This includes 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 formats.

Due to the worldwide prominence of ISO standards, IHO S-100 will be based on the ISO suite of standards. However, alignment with the ISO 19100 series of geographic standards will require a re-structuring of IHO S-57. More specifically, this requires a new framework, and the use of new/revised terms used to describe the components of S-100.

IHO plans to release S-100 in late 2007/early 2008. However, S-57 3.1/3.1.1 will continue to be used 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, MIOs will continue to be produced based S-57 3.1/3.1.1. Following the adoption of any future ENC Product Specification based on S-100, a determination will be made on how to produce MIOs suitable for use with both S-57 and S-100 based ENCs.

Dr. Lee Alexander, Chair

Michel Huet, Secretary

IHO-IEC Harmonization Group on Marine Information Overlays (HGMIO)