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Recommended Citation

Alexander, Lee, "Marine Information Objects (MIO) and ECDIS: Concept and Practice" (2003). *U.S. Hydrographic Conference*. 263.

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Marine Information Objects (MIOs) and ECDIS: Concept and Practice

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Abstract: Marine Information Objects (MIOs) consist of chart- and navigation-related information that supplement the minimum information required by ECDIS to ensure safety of navigation at sea. As related 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. Such information includes ice coverage, tide/water level, current flow, meteorological, oceanographic, and marine habitats. A Harmonization Group on MIOs (HGMIO) has been 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 paper discusses the scope of MIO activities, particularly as it relates to the challenges of converting a wide variety of MIO-related information into suitable data formats for use with a type-approved ECDIS. This includes information that will be provided via shipboard Automated Identification Systems (AIS) and Vessel Traffic Service (VTS) centers. In particular, there are significant challenges related to developing data formats that deal with time-varying information (i.e., X, Y, Z and time), simultaneous display of MIOs with other chart and navigation-related information, and the means/process to disseminate in a timely manner.

Introduction

The advent of ECDIS equipment and ENC data has provided the mariner with a new navigation aid of tremendous potential. More than simply a replacement for a paper chart, ECDIS is a computer-based navigation system that is capable of integrating a variety of information to be displayed and interpreted by the Mariner. As an automated decision aid capable of continuously determining a vessel's position in relation to land, charted objects, aids-to-navigation, and unseen hazards, ECDIS represents an entirely new approach to maritime navigation. However, to fully realize its potential, ECDIS must provide information beyond what is contained on a paper nautical chart.

The provision of supplemental information that is in addition to what is shown on a paper nautical chart is specifically mentioned in the IMO Performance Standards for ECDIS. In particular, the definition of an ENC states that it should contain “*all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart which may be considered necessary for safe navigation.*”[1] The IMO Performance Standards also stipulate that chart information to be used in ECDIS conform to IHO S-57 data standards, and that IHO colours and symbols be used to represent the System ENC information. While the current edition of IHO S-57 (Edition 3) contains an ENC Product

Specification, it does not specify the content or format for supplemental information. [2] Nor do the IHO Colours and Symbols Specifications for ECDIS (IHO S-52, Appendix 2) describe how this supplemental information should be displayed. [3].

Brief Background

Beginning in 1999, the IHO began to look into what constitutes supplementary information for ECDIS. It was decided that “Marine Information Objects” (MIO) would be an appropriately generic description for non-mandatory information not already contained in the IHO S-57 ENC Product Specification. Later that year, a MIO Organizational Workshop was held in Burlington, Ontario (Canada). One of the major outcomes was the realization that MIOs could be either chart- or navigation related information. Chart-related could include tides/water levels, current flow, seafloor classification, and marine habitats, while navigation-related could be own ship, radar based (e.g., automatic radar plotting aid or ARPA) Vessel Traffic Service (VTS), and Automatic Identification System (AIS). However, for some types of MIOs such as ice coverage or oceanographic parameters, they could be considered as being associated with either category. Since the IMO Performance Standards specify that the provision and display of chart-related information conform to IHO standards and that the display of navigational elements and parameters conform to IEC standards, it was proposed that a “harmonization” group on MIOs be established between IHO and IEC.

HGMIO

In March 2001, a letter was sent from the Chairman of IEC Technical Committee 80 to the Chairman of IHO CHRIS outlining the basis for the formation of a IHO-IEC Harmonization Group on Marine Information Objects (HGMIO). Draft Terms of Reference were exchanged in April 2001 and formally adopted in May 2002 [2].

It was agreed that HGMIO would be a subsidiary of two Committees:

- IHO Committee on Hydrographic Requirements for Information Systems (CHRIS)
- IEC Technical Committee No. 80 - Maritime Navigation and Radiocommunications Equipment and Systems (TC80)

As a technical liaison Working Group, HGMIO would:

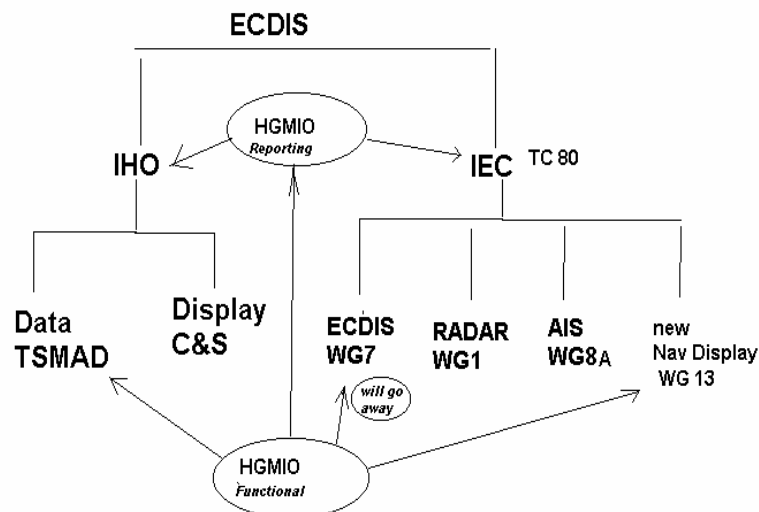
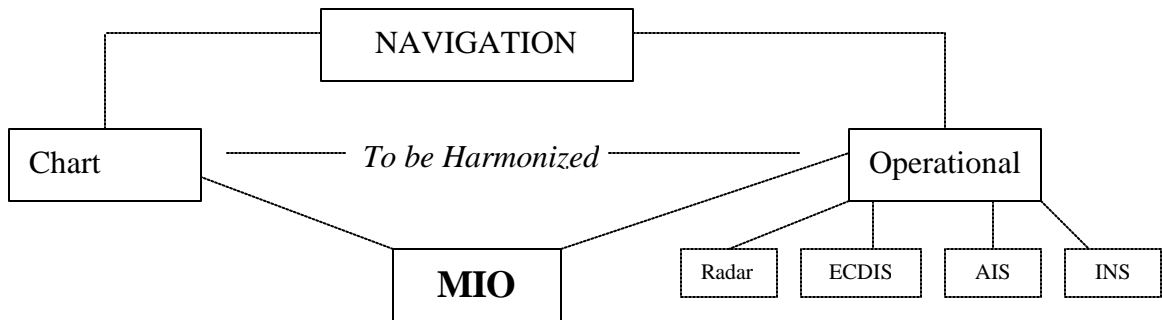
- a) Harmonize the activities of IHO and IEC related to the provision and display of supplemental chart- and navigation-related information on ECDIS.
- b) Conduct technical exchange on MIOs with type-approval authorities, ECDIS manufacturers and ECDIS user community.
- c) Liaise with other organizations or Working Groups involved in ECDIS-related matters, including:

- IMO/IHO Harmonization Group on ECDIS (HGE)
- International Association of Lighthouse Authorities (IALA)
- World Meteorological Organization (WMO)
- North Atlantic Treaty Organization (NATO)

When instructed by IHO CHRIS or IEC TC80, HGMIO would recommend changes/additions to:
IHO S-57, IHO Digital Data Transfer Standard

IHO S-52, Appendix 2 - Colours and Symbols Specifications (for ECDIS).
 IEC 61174, Annex E - Display of Navigation-related Information (in ECDIS).
 IEC 62288 (Shipboard Navigation Display)

The following two diagrams show the operational, functional, and reporting relationships between the various IEC and IHO Committees/Working Groups:



The HGMIO would be comprised of individuals who are participating members of standing IHO and IEC committees or working groups. The HGMIO is to keep abreast of other ECDIS-related developments and performance standards that involve the display of additional navigation-related information. This includes IMO Performance Standards and Guidance for Automatic Identification Systems (AIS) [5 & 6] and VTS-related information proposed by IALA [7]. However, new standards for MIOs would not be adopted without first conducting comprehensive testing and evaluation, validation by ECDIS manufacturers, and at-sea trials with mariners.

The First Meeting of HGMIO was held 15-16 January 2002 at the University of New Hampshire (Center for Coastal and Ocean Mapping – Joint Hydrographic Center), Durham, New Hampshire, USA. The primary objectives of this meeting were to clarify the focus/scope of the Terms of Reference, review the status of MIO-related efforts, discuss the relationship of HGMIO

to other IHO and IEC Committees/Working Groups, and to agree on a overall work plan/approach for dealing with MIO-related standards development.

The initial discussion of MIOs focused on previously developed or proposed IHO S-57 objects/attributes and IHO-52 colours and symbols. A review of the current status of MIO-related efforts or categories included:

- Ice Information
- Meteorological
- Tides/Water Levels
- Current Flow
- Oceanographic
- Marine Habitats
- Environmental Protection
- Vessel Traffic Services (VTS)

Planned/Future Efforts

The current editions of IHO S-57 and IHO S-52 deal primarily with the encoding and display of ENC data to be used in ECDIS. However, IHO plans to expand these standards in order to deal with other types of hydrographic data. Target date for completion of Edition 4.0 for each standard is 2005. In support of the work of IHO, HGMIO will be assisting TSMAD and C&SMWG in how to deal with “other types” of supplemental information including:

- bathymetric (including bathymetric grid data)
- tides (real-time, predicted, and forecast)
- geophysical data (seismic, gravity, magnetic)
- bottom structure/physiography
- sonar imagery (sidescan, multibeam, LIDAR)
- horizontal datum parameters
- salinity and temperature profiles
- sediment type/classification
- sound speed profiles (CTD data)
- current flow (speed, direction, time of occurrence)
- satellite imagery
- aerial photography (orthogonal and oblique)
- ROV and AUV video imagery
- archeological (wrecks, heritage sites)
- marine environmental protection (environmentally sensitive sea areas)

While it is not expected that it will be feasible (or desirable) to try “standardize” all of these types of data/information, there is a need to consider each in the context of existing or planned standards (e.g., IHO S-57/S-52, IEC 61174 & 62288, or ISO TC211). Also, while there may be benefits for the next edition of IHO S-57 being able to make provision for temporal, raster, and matrix data, there may be a less compelling need to specify how it should be displayed.

In looking ahead, there is growing interest within the maritime community to be able to use information from a variety of sources, and to use it in conjunction with existing shipboard equipment and systems. However, there are significant challenges related to developing robust

data formats capable of dealing with time-varying information (i.e., X, Y, Z and time). There is also a concern about the simultaneous display of MIOs with other chart and navigation-related information, and the potential impact in terms of an overly cluttered display. Another aspect that must be considered is the means/process to disseminate ever-increasing amounts of information.

One way to view these challenges is in the context of the “three rules of military intelligence”:

Rule #1 – What you need you cannot get (even if you know it exists).

Rule #2 – When you get it, it will be in a format you cannot use (e.g., encrypted data format, wrong type of equipment, out-of-date software, unintelligible display, lack of geo-reference)

Rule #3 – When you are finally able to use the information, it is now of date (back to Rule #1). [8]

In the longer term, it will eventually be realized that the real benefit of being able to use supplemental information will be for decision support (i.e., “what if”). This will be a far more important consideration than what it looks like when displayed. However, it is human nature to judge information by its appearance. In this regard, it will be some time before there is a realization that what is displayed depends on the task at hand and the preference of the user. For MIOs, the main challenge will be to agree upon suitable formats capable of providing ever-increasing types of information in a timely fashion.

References

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- [6] *IMO Interim Guidelines for the Presentation and Display of AIS Target Information*, IMO SN/Circ.217, 11 July 2001. (5 pages)
- [7] *IALA Guidelines on Universal Shipborne Automatic Identification System (AIS)*, Version 1.0, December 2001 (157 pages).
- [8] Buizert, Q.P.F., Linas Pilypaitis, and Lee Alexander. 1998. *NATO Warship ECDIS: Concept and Capability*. Proceedings: International ECDIS Conference, Singapore. 26-28 October. pp. 308-314.