CHRIS17-5.1D

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ENC PRODUCT SPECIFICATION OPTIONS

TSMAD

1. Summary

Executive summary:	IHO CL 26/2005 discussed the present situation with respect to the concerns about the future status of the current ENC Product Specification and the impact of ongoing work on S-57 Edition 4.0. The attached paper discusses four options for addressing this issue and their consequences.
Actions to be taken:	The CHRIS committee is asked to direct TSMAD as to which option for future ENC development is to be undertaken.
Related documents:	ENC Product Specification Options

2. Introduction / Scope

Please refer to attached Paper.

3. Analysis/Discussion.

Please refer to attached Paper.

4. Benefits.

Please refer to attached Paper.

5. Working Groups.

TSMAD
C&SMWG

6. Other relevant information.

None

7. Priority.

High

8. Target completion date.

N/A

9. Action Required.

CHRIS is requested to select option(S) for TSMAD to implement for future ENC Product Specification.

ENC Product Specification Options

Introduction

Development of a new Electronic Navigational Chart Product Specification (ENC PS) has been on the TSMAD work program since it was approved by CHRIS. At present, a future ENC PS using S-57 Edition 4.0 (ENC PS 4.0) is still some years away. The time frame for this development depends on several factors. The primary factor is when all of the components of the new standard are completed and available to use in creating a new product specification. The second factor is the ability of the S-57 stakeholders to contribute to the development as well as support the new product when it is completed.

There are a number of issues with the current ENC PS under S-57 Edition 3.1 that are identified in the following section. The goal of a future ENC PS 4.0 is to address all known issues and incorporate design changes that will prevent the same types of problems from arising in the future. Recently, the time frame for development of a future ENC PS 4.0 has been discussed as to whether it should be issued as soon as practical or delayed for some length of time. In these discussions, the topic of an 'interim' revision of S-57 Edition 3.1 has been reintroduced. This has resulted in this request from TSMAD for CHRIS to provide direction on what approach to take and an approximate time frame for development.

Note that work on an interim solution will take resources away from developing Edition 4.0. Also, our experience with the change from 3.0 to 3.1, which only included minor extensions as opposed to the more extensive changes currently required, demonstrated that:

1) For ECDIS, implementing any change will be difficult and will affect the entire ECDIS community;
2) Any changes will have to be coordinated with ECDIS manufacturers, IEC, IMO and within IHO (C&SMWG), as the changes may require significant changes to the Presentation Library.
3) The re-issuing of an HO's portfolio of ENCs is a costly process and in some cases is impossible to execute in the short to medium term.

Issues with current ENC PS

Since the 'freezing' in 2001 of S-57 Edition 3.1 and its associated ENC PS, numerous deficiencies in the standard have come to light. These include errors in the base standard and ENC PS as well as features that were overlooked when the standard was written. Examples of features that were omitted include: areas with minimal bathymetric data, information areas, IALA special purpose beacons and buoys; and some that have been added in recent years include: Archipelagic Sea Lanes (ASL), AIS transmitters on aids to navigation, Particularly Sensitive Sea Areas (PSSA), and so forth. A number of these types of new features have been mandated by IMO for inclusion on charts and are, in fact, already on paper charts but cannot be adequately encoded in the ENC or displayed on an ECDIS. While these features do not exist in all national waters, they do affect any ships using ECDIS that transit waters where they exist. In some cases, entering a PSSA can result in substantial fines to the vessel operator while leaving the protection of an ASL could result in the loss of the vessel, both of which are strong arguments for including them in ENC without using a workaround solution. In the future, as new deficiencies in the design of the current ENC PS become apparent it is not possible to

correct them while S-57 is frozen. This situation will be a crisis if an issue that directly affects safety-of-navigation or regulatory requirements is identified and no temporary workaround solution can be found within the constraints of Edition 3.1. While a Marine Information Object (MIO) could be used as a short-term option for including additional information that an ENC does not currently support (e.g., PSSA), MIOs contain optional, not mandatory information to be used in conjunction with an ENC and are thus not suitable for features that affect safety of navigation.

Inconsistent ENC data between producing Hydrographic Offices (HO) has resulted from some ambiguity in parts of the current standard. The current ENC PS is vulnerable to multiple interpretations which has created inconsistent implementation between ENC producers. The results are inconsistencies between ENCs that the mariner is left to resolve. This situation has been addressed by a number of clarifications and encoding guidance instructions published in a recent Circular Letter, or as Web based Encoding Bulletins and Frequently Asked Questions. Thus a producer has to refer to a variety of documents and Web sites to find all guidance on how to produce ENC data. This situation can lead to further inconsistency as some producers may not follow all of these 'highly recommended' procedures and/or have already encoded their entire portfolio in an alternate way.

The current version of the ENC PS has no ability to add or change features (e.g., ASL, PSSA, etc.) as they are added to other products (e.g., paper chart) without affecting the associated standards (e.g., S-52, IEC61174, IMO ECDIS PS, S-58, etc.) and requiring changes to software (e.g., ECDIS, production systems, quality assurance software, etc.). To incorporate new feature requirements, HOs are using existing features not designed for these new requirements as workaround encodings which result in the features not being discernable nor apparent to the mariner. An example of such a workaround could be the encoding of ASL as a fairway (note that no work around encoding for ASL has been recommended by TSMAD at this time). The ASL axis line that actually defines the legal limits of the feature is not encoded at all and the outer limits are encoded as a fairway area with 'archipelagic sea lane' recorded in the information field. This means that on an ECDIS, the mariner just sees a fairway and has to use a pick report to query it and read that it is an ASL. The ECDIS cannot provide any different representation of the area or any alarms or warnings related to it if encoded in this way. The ability to add new features to a future ENC PS in a manner that allows for a regular, controlled update to existing systems is a deficiency in the current standard that should be addressed in the next version.

There are other deficiencies in the standard besides the inability to encode certain features. For example, it has been recently noted that the current version has no facility that will allow an ECDIS to check to see if the loaded portfolio of ENCs is up-to-date. While the standard has the ability to provide Notices to Mariners type updates to the cells, the system cannot determine if a cell has had all of the required updates applied to it, other than if a new update arrives that does not sequentially follow the previous one. As an example, an ECDIS may have a cell that was last updated two months ago. In the past two months, other cells in the portfolio may have had updates applied to them. The system has no way to check to see if the cell in question has simply had no updates distributed for it or if they were missed somehow in transmission or

application. Similarly, a vessel inspector will have a difficult time verifying that all of the cells in the system have all of the relevant updates applied to them.

Technology is rapidly advancing. For example, new survey systems are providing rich data sets that can be used to provide detailed bathymetry. Real time tide gauge and current data are becoming increasingly available. Without any ability to change, ENC cannot take advantage of new technologies such as these that could significantly enhance safety of navigation in this era of pushing minimum under keel clearances.

Finally, the interoperability of ENC data with other navigational products and GIS data continues to be an issue with the current standard. For as long as ENC and Digital Nautical Chart (DNC) data has existed, there has been a desire to easily convert data back and forth. There are a number of differences between these standards that prevents this. The DIGEST group have begun work to restructure their standards to use the ISO geospatial standards with a great deal of input from TSMAD members and participating HOs so that any future versions of S-57 and DIGEST will be compatible from the core level up. Similarly, changes being incorporated into Edition 4.0 are intended to facilitate interoperability with other products such as Inland ENC and AML.

Any number of options for addressing these issues can be described. TSMAD identified four that cover the range of options available. These are presented below starting with a 'no changes' option, then in order of increasing amounts of change to the ENC PS.

Option 1: Retain the current ENC PS with no replacement in work

While this option would not have any effect on systems, regulations or data producers, all of the deficiencies and pending corrections described above would remain unresolved.

As more features are encoded using workarounds, the options for how to display or use the information on an ECDIS are severely limited. For example, a wide variety of important area features are encoded by using the generic feature 'caution area' combined with a note in the 'information' attribute. An ECDIS cannot use this information to provide required indications/alarms or proper symbology. This forces the mariner to use the pick report function to click on the area and read textual information describing what it is. Furthermore, there is no indication to the mariner that a pick report is needed to reveal that a feature has an alternate encoding. Because of the numerous caution areas being encoded, the importance of a 'real' caution area is being undermined by this work around. As time passes and the number of workarounds increases and the volume of data produced using them grows, it will become more difficult to migrate existing data into any revised ENC PS because the features will have to be recoded using the new, corrected encoding.

It has been suggested that the features that are not supported by the current ENC could be incorporated into a new MIO product. While an MIO product could be designed to do this, use of such a product would be optional under the current regulatory structure. This would mean that they would not be available to all ECDIS users and could be portrayed differently on various systems. In order to make their use mandatory, all of the relevant standards and regulations would have to be changed and support for the use and display of any new MIO

product would require the same type of modifications to all ECDIS systems that a new edition of S-57 would require. For these reasons, putting these features in to an as yet to be defined MIO product or other similar non-ENC solution is not an acceptable option for information that should be contained in the ENC. As HOs may have information in their offices about new features such as ASLs and PSSAs, if they do not encode them on all their navigational products, they may be open for litigation in the event of an accident associated with these features being omitted from ENCs.

Option 2: Develop and issue a "minor" interim version based on Edition 3 (i.e., 3.1.1)

A minor revision would only include new features that are navigationally significant or affect regulations and would thus be considered an extension, not a replacement for the current version. This means that a minor revision must not invalidate 3.1 or its encoding requirements which results in the requirement that 3.1 data must continue to be produced for use in current ECDIS.

In this option the standard would not be changed to introduce a mechanism for accommodating changes in the real world (that will likely continue in the future) and these changes will then require additional interim versions (e.g., 3.1.2, 3.1.3, etc.). By requiring that 3.1 remain valid for use, HOs that elect to produce data using a new version **must** also produce and maintain data using all previous interim versions as well as 3.1 for use in ECDIS that have not upgraded to accept the new data. In addition, ECDIS that have implemented support for 3.1.1 data **must** also continue to support 3.1 data.

This option would also result in the same real world feature being encoded in different ways in the various interim versions, resulting in different displays and information being available on different systems. An example would be an archipelagic sea lane (ASL) in 3.1 being encoded as a fairway with no axis line (work around) and encoded appropriately in 3.1.1 as a new ASL object with a separate axis line object as well. Thus the 3.1.1 implementation would show it correctly on an upgraded ECDIS, however, since the 3.1 implementation remains valid under this option, having the ECDIS upgraded and using the new 3.1.1 data becomes effectively optional. This would result in features approved by IMO for inclusion on paper charts not being encoded in all ENCs and available on all ECDIS.

Distribution would be made more complex as RENCs and distributors will have to manage multiple versions of the same ENC coverage for customers who will have ECDIS with different capabilities. Updates to ENCs would also become more complex requiring different corrections for different versions. By making the distribution and use of ENC data more complex, it is more likely that safety could be compromised due to problems keeping track of data. For example a vessel could erroneously receive a version of the data that is incompatible with its ECDIS. From the mariner's perspective, this could increase the complexity of managing a portfolio and result in further confusion.

This option would also require additions to the S-52 Presentation Library (PL) which would delay implementation even further, especially as there must be a substantial lag time after the issue of a new PL and the take up by OEMs for the various type approved ECDIS.

Option 3: Develop and issue a "major" interim version based on Edition 3 (i.e., 3.2)

A major interim version could supersede Edition 3.1 after a transition phase and would be a mandatory change for ECDIS. This would require examining all related regulations and standards (S-52, IEC61174, IMO ECDIS PS, S-58, etc) to determine if they need to be changed to reflect the new version as well as requiring an update of all affected systems (e.g., ECDIS, production software, etc.).

The scope could include all deferred changes from the frozen maintenance documents as well as new features. This would provide an opportunity to address some of the work around solutions currently used. New IMO approved features would be properly encoded and ENCs would be produced with greater consistency.

This option would not provide the ability, however, to change any deficiencies that are related to the structure of the current edition of S-57 and the ENC PS. As with the minor revision, changes in the real world will likely continue in the future that will require additional interim versions (e.g., 3.3, 3.4, etc) due to the fact that the interim solution will not add the capability for a built in maintenance mechanism.

Since no new functionality would be introduced into the base standard, none could be included in a revised ENC. Thus no support for enhanced or gridded bathymetry, time variant features and so forth could be included.

This option would also require additions and modifications to the S-52 Presentation Library (PL) which would delay implementation even further, especially as there must be a substantial lag time after the issue of a new PL and the take up by OEMs for the various type approved ECDIS.

Finally, some HOs would not be able to migrate to 3.2. During the transition period, HOs would have to maintain support for 3.1 as well as 3.2.

Option 4: Develop and issue a new ENC PS based on Edition 4.0

Edition 4.0 could supersede Edition 3.1 after a transition phase and would be a mandatory change for ECDIS. This would require examining all related regulations and standards (S-52, IEC61174, IMO ECDIS PS, S-58, etc) to determine to what extent they will need to be changed to reflect the new version.

The only way to address all of the known deficiencies in the current ENC PS is to completely replace S-57 Edition 3.1 with a new edition that incorporates more flexible structures that would allow for a built in capability to update the ENC PS. For example, the ability to produce updated catalogs of features that could be automatically loaded into an ECDIS would eliminate the current problem of a frozen standard that cannot change to reflect real world requirements. Support for these features will have to be included in the other relevant ECDIS standards and specifications as well. All features in a new ENC PS will be able to be encoded properly with no work around solutions. The ECDIS will use this information to properly sound alarms and display appropriate symbology.

An Edition 4.0 ENC will be able to include new functionality that will be included in the standard (e.g., imagery and gridded data, time varying information, etc.). Interoperability with other systems and data (e.g., DIGEST, AML, and Inland ECDIS) will be greatly enhanced by using international standards and widely supported file formats (e.g., GML). These enhancements will allow for features such as integrated real-time tide data and high resolution bathymetry data, although such features may require significant changes to the Presentation Library.

Since the 4.0 ENC PS is in its infancy, ECDIS manufacturers are able to fully participate in its development.

As with option 3, some HOs would not be able to migrate to 4.0; however, this will be less likely in that the timeline for the development of an Edition 4.0 ENC PS is significantly longer. During the transition period, HOs would have to maintain support for 3.1 as well as 4.0.

Transition Plan

A transition plan to move from Edition 3.1 to any future ENC PS must be developed. Such a plan will have to be developed in collaboration with all stakeholders, including: IMO, IEC, RENCs, ECDIS manufacturers, type approval authorities, users, production software companies, other IHO working groups, HOs and regulatory agencies. Due to the fact that this work will span multiple stakeholders it must take place at a level higher than a technical working group. While this coordination is taking place, the various ECDIS standards and specifications will need to be reviewed to support any new features included in a new ENC PS.

Summary

- The Ed 4.0 ENC PS has always been part of the work plan initially approved by CHRIS.
- The current ENC PS has many deficiencies and new ones are turned up as time goes on.
- New requirements keep coming to light (PSSA, ASL, AIS, etc.);.
- Many of the deficiencies in 3.1 cannot be fixed by an interim release but only by an Ed 4.0 scale revision.
- Any changes made to the ENC PS will be difficult to implement.
- An interim release will fix what we know about now, but a delay in Ed 4.0 means that there will have to be more interim releases.
- A key concept of Ed 4.0 will be a method to make future standards updates in a more controlled, implementable fashion.

A table summarizing the options and their consequences is provided at Annex A.

Action requested

TSMAD asks CHRIS17 to provide direction on which option(s) for the ENC Product Specification TSMAD should implement. Guidance on the expected timeframe for completion is also needed.

Annex A

The following table summarizes many of the issues discussed in this paper. Issues related to the scope of a particular option are grouped first, followed by the consequences of implementing a particular option.

Option	1	2	3	4
Scope				
Relative Magnitude of Change	0	1	3	5
What is Included (Catalog-Maintenance)	N/A	7-None	60-Most	60-All
Is Use Mandatory	No	No	Yes	Yes
Transition Period Required	No	No	Yes	Yes
Approximate Timescale for TSMAD	N/A	2006	2008	2009
Consequences				
Regulations, Standards, Systems Impacted	No	No[1]	Yes	Yes
Multiple Encodings	No	Yes[2]	Yes[3]	Yes[3]
More Interim Releases	No	Yes	Yes	No
Producer Migration Problems	No	Yes[4]	Yes	Yes
Correct Symbology and Warnings	No	Yes[5]	Yes	Yes
Core Deficiencies Addressed	No	No	No	Yes
New Functionality Support	No	No	No	Yes
Interoperability Support	No	No	No	Yes

1 Systems manufacturers that choose to support the interim version will have to develop support.
2 Only where ENCs that have new objects/attributes are implemented.
3 During transition phase while two versions are valid.
4 Since adoption is optional for a producer, those not adopting would have no migration problems.
5 Only where ENCs are produced using the new encodings and are used on an upgraded ECDIS (which is not a mandatory upgrade).

Definitions

Relative Magnitude of Change: This is an approximation of the relative degree of change involved in each option with zero representing no change and five representing the maximum amount of change.

What Is Included: The first numeric value indicates the approximate number of new features or attributes to be introduced. The second entry indicates how much of the pending changes in the S-57 Maintenance Document and ENC Encoding Bulletins would be included in the new version.

Is Use Mandatory: This field indicates if all producers and users will be required to upgrade their systems to use the new version of the ENC PS.

Transition Period Required: In the case of a mandatory change to a new version, is it required to have a period where both 3.1 and the new version are valid with 3.1 becoming invalid at

some time. Note that in any case, a new version, whether mandatory or not, will result in an implementation period where new symbology and software will have to be developed and deployed.

Approximate Timescale for TSMAD: This is an estimated date for the publication of a new version of the ENC PS. Note that software development can work in parallel to a large extent with the ENC PS development such that new systems could be available almost at the same time that the new ENC PS is published.

Regulations, Standards, Systems Impacted: Are the various related regulations, standards and software systems affected by the option?

Multiple Encodings: Will there be different ENCs available to the mariner covering the same area at the same scale that have the same feature encoded in different ways? Note that this also means that producers will have to maintain the feature in multiple encodings as well.

More Interim Releases: Will additional interim versions of the ENC PS be required after the implementation of a particular option?

Producer Migration Problems: Will implementing an option result in data migration problems for a producer?

Correct Symbology and Warnings: Will implementing an option result in an ENC that will allow an ECDIS to provide correct symbology and appropriate warnings for a particular feature? Note that in order for this to happen, the colors and symbols and the ECDIS software would have to be updated.

Core Deficiencies Addressed: Are deficiencies with the current standard (e.g., the current standard does not support checking the up to date status of a vessel's portfolio of ENCs) corrected by implementing an option?

New Functionality Support: Does an option allow for the inclusion of new functionality such as gridded bathymetry data?

Interoperability Support: Does an option provide improved interoperability with other navigational products such as DNC or Inland ENC?