CHRIS17-INF2

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Information Paper for Consideration by CHRIS

AGENDA ITEM 13.1: Review of Information Papers

ENCs and Spatial Data Infrastructures (SDI)

Submitted by:	IHB (M. Huet)
Executive summary:	Spatial Data Infrastructures (SDI) aim at sharing geospatial data in a global, regional, national or local environment. Currently, ENCs are made available to users through ENC services provided by the existing two RENCs and/or by a number of Hydrographic Offices. Those various services are generally uncoordinated, limited to marine navigation and do not include products other than ENCs. The development of a SDI in the maritime sector and the setting up of a Nautical Geospatial Portal would contribute to significantly increase the dissemination and use of the spatial data produced by HOs. The annexed paper, presented to ICC 2005 (A Coruña, Spain, July 2005), intends to identify the convergence issues between both following approaches to share geospatial (navigational) data: RENC and SDI.
Actions to be taken:	The meeting is invited to take note of this paper, in particular in view of the forthcoming IHO SDI-Seminar "The role of Hydrographic Services with regard to geospatial data and planning infrastructure" to be held in Rostock, Germany, 8-9 November 2005.
Related documents:	CL 22/2005

Annex to CHRIS17-INF2

ENC and SDI: Convergence Issues

(Paper presented to the 2005 International Cartographic Conference, A Coruña, Spain, 10-16 July 2005)

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ABSTRACT

Electronic Navigational Charts (ENC) are official nautical charts produced by national Hydrographic Offices in accordance with the International Hydrographic Organisation's (IHO) ENC product specification, as contained in S-57 (IHO Transfer Standard for Digital Hydrographic Data), and which are designed primarily for use on Electronic Chart Display and Information Systems (ECDIS).

The ENCs distributed via a RENC (Regional ENc coordinating Centre) service meet SOLAS (Safety Of Life At Sea convention of the International Maritime Organization - IMO) chart carriage requirements when kept up to date and used on an ECDIS with suitable backup.

Spatial Data Infrastructures (SDI) aim at sharing geospatial data in a global, regional, national or local environment. The hypothesis proposed in this work could be enunciated as follows: it is possible to model Electronic Navigational Chart Services into Spatial Data Infrastructure frameworks. During the research carried out, this concept is demonstrated by means of multiple criteria.

This paper intends to identify the convergence issues between both following approaches to share geospatial (navigational) data: RENC and SDI. To that purpose, an Open Distributed Process – Reference Model (ODP-RM, ISO/IEC 10746) is used, to compare the characteristics of both approaches into the five perspectives proposed by ODP-RM: enterprise, information, computation, engineering and technology.

This forms the initial part of a more comprehensive research that is being undertaken by the authors as part of their activities within the ICA Spatial Data Standards Commission.

1. INTRODUCTION

The International Maritime Organisation (IMO) is a United Nations specialised agency which issues conventions, ratified by countries, to regulate worldwide maritime safety. As part of this activity, it establishes reference standards for electronic chart display and information systems (ECDIS) used by regulated shipping. These conventions reference standards created by the International Hydrographic Organisation (IHO), a scientific and technical organisation which creates international minimum standards covering hydrography and nautical charting. IHO is an intergovernmental organisation not affiliated to the UN. The secretariat of IHO is called the International Hydrographic Bureau (IHB). The IHO publishes a Transfer Standard for Digital Hydrographic Data (commonly known as S-57) (Greenway, 2002).

S-57 is also a means to share geospatial information between Hydrographic Offices once such information is co-ordinated by the Regional ENC co-ordinating Centers (RENC). In a high level of abstraction, the RENCs can be considered ”World Hydrographic Data Centers”, to allow the distribution of nautical charts to the users (shipping industry and mariners) in accordance with the S-57 standard.

In this paper, it is proposed to associate two important achievements / concepts in geospatial technology: the robust and well-established Electronic Navigation Charts and the Spatial Information Infrastructures, with a view to an increased sharing of the geospatial information contained in nautical charts, in an ubiquitous context through Geospatial Portals.

The thoughts presented in this paper do not aim at replacing the existing RENCs and Distributors/VARs in their essential role in ENC distribution; instead it is proposed to spread the possibilities to access nautical geospatial information and to encourage the setting up of new value added services to this specialised (nautical) geospatial information.

2. REFERENCE MODEL OF OPEN DISTRIBUTED PROCESSING (RM-ODP)

The model provided in this paper is based on ISO/IEC 10746 Open Distributed Processing Reference Model (ISO/IEC, 1995). ISO ODP Reference Model identifies five viewpoints, or perspectives, on information technology:

- **Enterprise viewpoint**: A viewpoint on an ODP system and its environment that focuses on the purpose, scope and policies for that system.
- **Information viewpoint**: A viewpoint on an ODP system and its environment that focuses on the semantics of information and information processing.
- **Computational viewpoint**: A viewpoint on an ODP system and its environment, which enables distribution through functional decomposition of the system into objects which interact at interfaces.
- **Engineering viewpoint**: A viewpoint on an ODP system and its environment that focuses on the mechanisms and functions required to support distributed interaction between objects in the system.
- **Technology viewpoint**: A viewpoint on an ODP system and its environment that focuses on the choice of technology in that system.

3. MODELLING THE SHARING OF NAUTICAL CHARTS BASED ON RM-ODP

Following RM-ODP, the model of ENC Services, in the first four viewpoints, is described in this section. In a first step, the actual ENC processes (without SDI orientation) are described. A general model of ENC provided by SDIs is then presented.

3.1 Describing the Actual ENC Systems.

3.1.1 Enterprise Perspective

Purpose:
An ENC is “a specially compiled database… that is issued officially by or on the authority of a Government, authorized Hydrographic Office and other relevant government institution and is designed to meet the requirements of marine navigation.”[1]

Actors:

[1] Safety of Life at Sea Convention Chapter V, Regulation 2

- Producers: National Hydrographic Offices (HOs)
- Providers: RENCs; HOs
- Brokers: Distributors; Value Added Resellers (VARs)
- OEM (Original Equipment Manufacturers): ECDIS Manufacturers; Software Developers (ECDIS Kernels; ENC Validation Programs; GIS Applications)
- Users: Shipping Industry; Mariners; GIS Users

Activities by actors:

- HOs produce and validate the ENCs. Production may be partly subcontracted to the private sector.
- RENCs are associations of HOs cooperating to harmonize the production and distribution of high quality ENCs, around a central, independent and non-profit making organisation as visualised in the WEND[2] principles of the IHO.
- Distributors and VARs are companies that have practical experience in S-57, and who are able to offer attractive and comprehensive end-user services that bring together various navigational products into one package.
- OEMs include companies that make ECDIS equipment and/or software (kernels); those that develop ENC validation software tools; and those developing various GIS applications using ENC data.
- Shipping industry acquires ECDIS and/or ENCs; Mariners use ENCs on ECDIS onboard ships; GIS users may use ENC data for various applications.

Policies:

Production, distribution and use of ENC/ECDIS are regulated by policies defined by the IMO, IHO, IEC[3], RENC and HOs.

- IMO: SOLAS Convention; Performance Standards for ECDIS.
- IHO: WEND Principles; Standards and specifications contained in IHO publications S-52, S-57, S-58, S-61, S-62, S-63 and S-64.
- IEC: ECDIS Test Standard 61174.
- RENC: Selection of ENC validation tools; Appointment of data distributors; Pricing.
- HOs: ENC encoding rules; Selection of ENC validation tools; Pricing.

3.1.2 Information Perspective

Information content:

Description of the sea bottom by contour lines, soundings and other features, e.g. wrecks or rocks, with emphasis on where to navigate safely. Indication of fairways and aids to navigation, e.g. lights, buoys and beacons. Indication of administrative features, e.g. traffic separation schemes or port limits. Simplified description of coastal topographic features, with emphasis on landmarks, e.g. towers.

Semantic of the information:

ENC data is encoded as features, feature attributes and enumerants. Each feature is located by two rectangular coordinates on a plane representing the surface of the oceans. The 3rd dimension, e.g. sounding value or elevation, is treated as an attribute. Geometry in the data structure is described in terms of edges and nodes which are topologically linked.

Metadata (three levels):

1. ENC file header: metadata common to all features in the ENC, e.g. edition number. Metadata are listed in Section 7.3 of S-57 “Data Set Descriptive Records”.
2. Meta features: metadata common to all features within a limited area, e.g. vertical datum. Metadata are listed in Section 1.3 of S-57 Appendix A, Chapter 1 “Meta Object Classes”.

[2] Worldwide ENc Database
[3] International Electrotechnical Commission

3. Attributes for individual features. Metadata are listed in S-57 Appendix A, Chapter 2 "Attributes".

3.1.3 Computation Perspective

Services:

- Quality assurance and quality control services (HOs, RENCs).
- Services of marketing, contracting, pricing, invoicing, royalties (to HOs), data protection, FTP (RENCs)
- Services of FTP, data protection, payment (Distributor / VAR).
- Services of packaging, mailing, invoicing, data protection (Distributor / VAR).
- Service of administration of data protection scheme (IHB).
- ENC updating services (HO, RENCs).
- Services of human interaction (ECDIS).

3.1.4 Engineering Perspective

ENCs will normally be delivered on CDs, on the occasion of a port call of the ship. ENC updates will be delivered to ships either on CD at port calls, or by e-mail, e.g. via satellite. ENCs and their updates may be available through the Internet. The following remote services take place:

- Uploading of ENC data from HOs to RENC server or FTP site.
- Downloading of ENCs by Data Distributors / VARs, from RENC FTP site.
- Transfer by e-mail of ENC updates from HOs to RENCs, then to distributors, then to users.

The WEND concept defines that interconnected RENCs act as clearinghouses for ENCs and their updates, which can be safely accessed from anywhere in the world, via a network of distributors. Current technology may limit to ENC updates, data delivery to ships at sea.

3.2 A New Approach to Share Nautical Geospatial Information Using SDIs

The current system depends on the sophistication of the user and his agent (VAR/Distributor). In many cases it is a "push" system. The mariner tells the agent his voyage and the agent provides him the ENCs necessary, usually by CD, and their subsequent updates, usually by e-mail. One could also envisage a pull system where the mariner accesses a GIS server on the Internet and pulls the necessary ENCs. As each ENC is retrieved for display an Internet query for updates could be launched and the updates applied.

Close to this approach, the concept of Spatial Data Infrastructure can also apply. "An SDI hosts geographic data and attributes, sufficient documentation (metadata), a means to discover, visualize, and evaluate the data (catalogues and Web mapping), and some method to provide access to the geographic data. Beyond this are additional services or software to support applications of the data" (Nebert, 2000).

To provide nautical charts on Geospatial Portals supported by SDIs, it is necessary to model them appropriately to meet the standards required by SDIs. The following steps could be undertaken:

1. Harmonize ENC metadata standards with ISO 19115 - Metadata (for compatibility with other geospatial information provided by SDIs) and develop tools to create ISO 19115-based ENC Metadata.

2. Search Map Servers (free software) conforming to OGC Web Map Servers, which can accept S-57 format, or develop software tools to provide S-57 nautical charts from Web Map Servers.

3. Establish clearinghouses or catalogue services to organize the searching of metadata and nautical geospatial data on Internet. One option could be to model the metadata as features in a Map Servers, so that the catalogue would be a map layer and would inherit all the map's functionalities (Delgado, 2005).

4. Create a Nautical Geospatial Portal to allow the access to all nautical charts (metadata and chart data) available in the world, and/or publish them on existing geospatial portals.

This would encourage the increased use of nautical information and generate new value added services.

4. CONCLUSION AND FUTURE WORK

Currently, ENCs are made available to users through ENC services provided by the existing two RENCs[4] and/or by a number of Hydrographic Offices. Those various services are generally uncoordinated, limited to marine navigation and do not include products other than ENCs. However, the importance of spatial data has increased considerably over the past few years, and the data have become an indispensable basis for economic activities. HOs are making considerable efforts to collect data covering the oceans, and they have accumulated an enormous wealth of spatial data. These data often are used for the sole production of navigational charts and other nautical publications. The data are far too valuable to limit their use to these applications. Moreover, the huge expanse of the world oceans is often left out of the current spatial data initiatives, although these areas are of great economic importance, in particular near the coasts.

The development of a SDI in the maritime sector and the setting up of a Nautical Geospatial Portal would contribute to significantly increase the dissemination and use of the spatial data produced by HOs. Examples of applications could include maritime transport, coastal zone management, environmental studies and disaster planning. These issues will opportunely be discussed at an IHO seminar "*The Role of Hydrographic Services with Regard to Geospatial Data and Planning Infrastructure*" to be held at the German HO (www.bsh.de) in Rostock on 8-9 November 2005. The IHO also follows closely various spatial data initiatives, such as the INfrastructure for SPatial InfoRmation in Europe (INSPIRE).

Finally, a new edition of the IHO standard S-57 is currently under development and is planned for release in late 2006. It will support a greater variety of hydrographic-related digital data sources, products, and customers that go beyond the scope of traditional hydrography, e.g. matrix and raster data, 3-D and time-varying data (x, y, z, and time). It will also conform to the ISO 19100 series of geographic standards and will enable the use of web-based services for data discovery, browsing, query, analysis, and transfer. It results that this new edition of S-57 should facilitate Hydrography getting into the evolving SDI world.

5. LITERATURE REFERENCES

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[4] Primar-Stavanger (www.primar-stavanger.org) and IC-ENC (www.ic-enc.org)

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