INTERNATIONAL HYDROGRAPHIC ORGANIZATION

Commentaire [JLP1]: ACTIONS still left:

1.Once the S-100 metadata schemas are in place review the S-101 metadata
2.Portrayal….
3. Add examples of different types of dataCoverage that are possible in S-101 (IG)

TSMAD27-4.4.1A

IHO ELECTRONIC NAVIGATIONAL CHART PRODUCT SPECIFICATION

November 2013

IHO Publication S-101
Electronic Navigational Chart Product Specification

NOTE: S-101 has various components that are in development. Therefore until it is at a final draft stage various items such as the main document, feature catalogue and data classification and encoding guide are not fully harmonized.

Published by the
International Hydrographic Bureau
MONACO

Version Number	Date	Author	Purpose
Phase 1	May 2009	J. Powell	Initial Draft
Phase 1	June 2010	J. Powell	Merged all the phases back into a single document
Phase 1	July 2010	J. Powell	Added comments from AHO
Phase 1	September	J. Powell	Revised based on FG discussions
Phase 1	December 2010	J. Powell	Revised based on TSMAD 21
Phase 1	February 2011	J.Powell	Revised based on comments to phase 1 from 2J, FR, AU.
Phase 2	April 2011	J.Powell	Revised based on comments from TSMAD22. Changed version to 0.1.0 to reflect movement to phase 2.
Phase 2	November 2011	J.Powell	Revisions made based on comments from discussion papers circulated post TSMAD 22
Phase 3	February	J.Powell	Revisions made based on TSMAD23 decisions
Phase 3	May 2012	J.Powell	Added TSMAD24 Decisions into document
Phase 4	August 2012	J.Powell	Edited document to reflect TSMAD24 decisions
Phase 4	November 2012	J.Powell	Added comments from October 2012 round of TSMAD comments
Initial Draft	March 2013	J.Powell	Added comments from January 2013 round of TSMAD comments.
Initial Draft	June 2013	J.Powell	Added decisions from TSMAD26.

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Introduction

S-101 is the Electronic Navigational Chart Product specification, produced by the International Hydrographic Organization. S-101 is designed to allow content, content definition (feature catalogues) and presentation (portrayal catalogues) to be updateable without breaking system implementations.

Based on S-100, S-101 includes all the necessary pieces for both Hydrographic offices to produce Electronic Navigational Charts (ENC) and OEMs to be able to ingest and properly display them. This product specification is designed to be flexible with the introduction of machine readable feature and portrayal catalogues that will allow for managed change and will enable the introduction of new navigationally significant features and their portrayal using a “just in time” methodology.

1 Overview

1.1 Scope

This document describes an S-100 compliant product specification for Electronic Navigational Charts, which will form the base navigation layer for an S-100 based ECDIS. It specifies the content, structure, and metadata needed for creating a fully compliant S-101 ENC and for its portrayal within an S-100 ECDIS. This product specification includes the content model, the encoding, the feature catalogue, portrayal catalogue and metadata.

1.2 References

S-100 IHO Universal Hydrographic Data Model

1.3 Terms, definitions and abbreviations

1.3.1 Use of Language

Within this document:

"Must" indicates a mandatory requirement.
"Should" indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.
"May" means "allowed to" or "could possibly", and is not mandatory.

1.3.2 Terms and Definitions

dataset
An identifiable collection of data

NOTE A dataset may be a smaller grouping of data which, though limited by some constraint such as spatial extent or feature type is located physically within a larger dataset. Theoretically, a dataset may be as small as a single feature contained within a larger dataset. A hardcopy map or chart may be considered a dataset.

ENC
The dataset, standardized as to content, structure and format, issued for use with ECDIS by or on the authority of a Government authorized Hydrographic Office or other relevant government institution, and conform to IHO standards. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart which may be considered necessary for safe navigation.

Feature
Abstraction of real world phenomena [ISO 19101:2003]

NOTE A feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

EXAMPLE The phenomenon named 'London Eye' may be classified with other phenomena into a feature type 'landmark'

Minimum Display Scale

The smaller value of the ratio of the linear dimensions of features of a dataset presented in the display and the actual dimensions of the features represented (smallest scale) of the scale range of the dataset.

Maximum Display Scale

The larger value of the ratio of the linear dimensions of features of a dataset presented in the display and the actual dimensions of the features represented (largest scale) of the scale range of the dataset.

1.3.3 Abbreviations

CRS	Coordinate Reference System
ECDIS	Electronic Chart Display Information System
EPSG	European Petroleum Survey Group
ENC	Electronic Navigational Chart
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization
SENC	System Electronic Navigational Chart
SOLAS	Safety of Life at Sea

1.4 S-101 General Data Product Description

NOTE This information contains general information about the data product.

Title: Electronic Navigational Chart

Abstract: An Electronic Navigational Chart (ENC) is a vector chart produced on the authority of a government authorized Hydrographic Office. Its primary purpose is for use within an Electronic Chart Display and Information Systems (ECDIS) to meet International Maritime Organization (IMO) and Safety of Life at Sea (SOLAS) chart carriage requirements. The ENC contains an extraction of real world information necessary for the safe navigation of vessels.

Content: The Product Specification defines all requirements to which ENC data products must conform. Specifically it defines the data product content in terms of features and attributes within the feature catalogue. The display of features is defined by the symbols and rule sets contained in the portrayal catalogue. The Data Classification and Encoding Guide (DCEG) provides guidance on how data product content must be captured. (Annex A)

Spatial Extent:

Description: Areas specific to marine navigation.

East Bounding Longitude: 180°

West Bounding Longitude: -180°

North Bounding Latitude: 90°

South Bounding Latitude: -90°

Purpose: The purpose of an ENC dataset is to provide official navigational data to an Electronic Chart Display and Information System (ECDIS) for the safe passage and route planning of vessels between destinations.

1.5 Data product specification metadata

NOTE This information uniquely identifies this Product Specification and provides information about its creation and maintenance. For further information on dataset metadata see clause 12.

Title: The International Hydrographic Organization Electronic Navigational Chart Product Specification

S-100 Version: 1.0.0

S-101 Version: 0.0.1

Date: October 2013

Language: English

Classification: Unclassified

Contact: International Hydrographic Bureau (IHB)

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B.P. 445
MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
Fax: + 377 93 10 81 40

URL: www.iho.int

Identifier: S-101

Maintenance: Changes to the Product Specification S-101 are coordinated by Transfer Standards Maintenance and Applications Development Working Group (TSMAD) of the IHO and must be made available via the IHO web site. Maintenance of the Product Specification must conform to IHO Technical Resolution 2/2007 (revised 2010).

1.5.1 IHO Product Specification Maintenance

1.5.1.1 Introduction

Changes to S-101 will be released by the IHO as a new edition, revision, or clarification.

1.5.1.2 New Edition

New Editions of S-101 introduce significant changes. *New Editions* enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types. *New Editions* are likely to have a significant impact on either existing users or future users of S-101.

1.5.1.3 Revisions

Revisions are defined as substantive semantic changes to S-101. Typically, revisions will change S-101 to correct factual errors; introduce necessary changes that have become evident as a result of

practical experience or changing circumstances. A *revision* must not be classified as a clarification. *Revisions* could have an impact on either existing users or future users of S-101. All cumulative *clarifications* must be included with the release of approved corrections revisions.

Changes in a revision are minor and ensure backward compatibility with the previous versions within the same Edition. Newer revisions, for example, introduce new features and attributes. Within the same Edition, a dataset of one version could always be processed with a later version of the feature and portrayal catalogues.

In most cases a new feature catalogue or portrayal catalogue will result in a revision of S-101.

1.5.1.4 Clarification

Clarifications are defined as non-substantive changes to S-101. Typically, clarifications: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; and insert improved graphics. A clarification must not cause any substantive semantic change to S-101.

Changes in a clarification are minor and ensure backward compatibility with the previous versions within the same Edition. Within the same Edition, a dataset of one clarification version could always be processed with a later version of the feature and portrayal catalogues, and a portrayal catalogue can always rely on earlier versions of the feature catalogues.

Changes in a clarification are minor and ensure backward compatibility with the previous versions

1.5.1.5 Version Numbers

The associated version control numbering to identify changes (n) to S-101 must be as follows:

New Editions denoted as **n**.0.0

Revisions denoted as n.**n**.0

Clarifications denoted as n.n.**n**

2 Specification Scopes

Scope ID: Root scope

Level: Dataset

Level name: ENC Dataset

3 Dataset Identification

A dataset that conforms to this Product Specification may be identified by its discovery metadata.

Title: Electronic Navigational Chart

Alternate Title: ENC

Abstract: S-101 ENCs must be produced in accordance with the rules defined in the S-101 Product Specification. The S-101 Product specification contains all the information necessary to enable

Hydrographic Offices to produce a consistent ENC, and manufacturers to use that data efficiently in an ECDIS to satisfy IMO Performance Standards for ECDIS.

Topic Category: Transportation (ISO 19115 Domain Code 018)

Geographic Description: Areas specific to marine navigation.

Spatial Resolution: An ENC dataset must carry values for minimum and maximum display scale. These define a scale range within which the dataset should be used. Values must be taken from the following table:

Scale
1:10,000,000
1:3,500,000
1:1,500,000
1:700,000
1:350,000
1:180,000
1:90,000
1:45,000
1:22,000
1:12,000
1:8,000
1:4,000
1:3,000
1:2,000
1:1,000

Table 1- ENC Minimum Display and Maximum Display Scales

Purpose: Electronic Navigational Chart for use in Electronic Chart Display and Information Systems

Language: English (Mandatory), other (Optional)

Classification: Data can be classified as one of the following:

Unclassified
Restricted
Confidential
Secret
Top Secret

Spatial Representation Type: Vector

Point of Contact: Producing Agency

Use Limitation: Not to be used for navigation on land.

4 Data Content and structure

4.1 Introduction

An S-101 ENC is a feature-based product. The content information is described in terms of a general feature model and a feature catalogue.

4.2 Application Schema

S-101 conforms to the General Feature Model (GFM) from S-100 Part 3. The GFM is the conceptual model and the implementation is defined in the Feature Catalogue. The S-101 Application Schema is realised in the feature catalogue and the product specification only contains specific examples.

4.3 Feature Catalogue

4.3.1 Introduction

The S-101 Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in an ENC.

The S-101 Feature Catalogue is available in an XML document which conforms to the S-100 XML Feature Catalogue Schema and can be downloaded from the IHO website. It is also be available in a human readable version.

4.3.2 Feature Types

4.3.2.1 Geographic

Geographic (geo) feature types form the principle content of the ENC and are fully defined by their associated attributes and information types.

4.3.2.1.1 Skin of the Earth

Each area covered by a meta feature **DataCoverage** must be totally covered by a set of geo features of geometric primitive type area from the above list that do not overlap each other (the Skin of the Earth). Skin of the Earth Feature Types are listed below:

DepthArea

DredgedArea

LandArea

UnsurveyedArea

The geometry of coincident boundaries between Skin of the Earth features must not be duplicated.

4.3.2.2 Meta

Meta features contain information about other features within a data set. Information defined by meta features override the default metadata values defined by the data set descriptive records. Meta attribution on individual features overrides attribution on meta features.

4.3.2.3 Aggregated

An Aggregated Feature Type is a feature which is made up of component features. See clause 4.3.3.2 for an example of an aggregated feature type.

4.3.3 Feature Relationship

A feature relationship links instances of one feature type with instances of the same or a different feature type. There are three types of defined feature relationships in S-101 as described in the following sub clauses.

4.3.3.1 Association

An association is used to describe a relationship between two feature types that involves connections between their instances.

EXAMPLE An **Isolated Danger buoy** feature marks a **Wreck** feature. An association named **Marks** is used to relate the two features; roles are used to convey the meaning of the relationship.

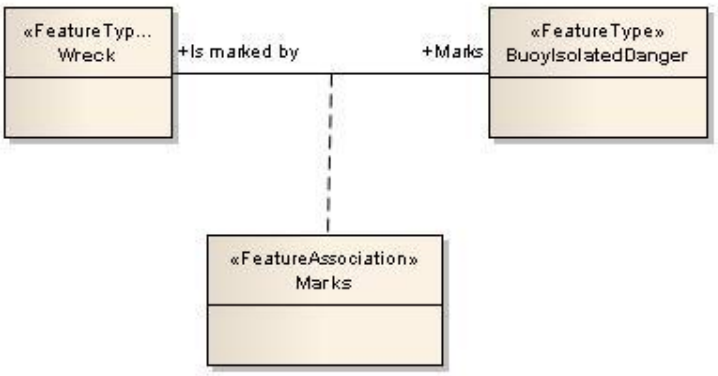


Figure 1 - Association

4.3.3.2 Aggregation

An aggregation is a relationship between two or more feature types where the aggregation feature is made up of component features.

EXAMPLE **Bridge** feature of type aggregation may be composed of multiple **Span** features and may also include **Lights** and other features which make up the **Bridge**

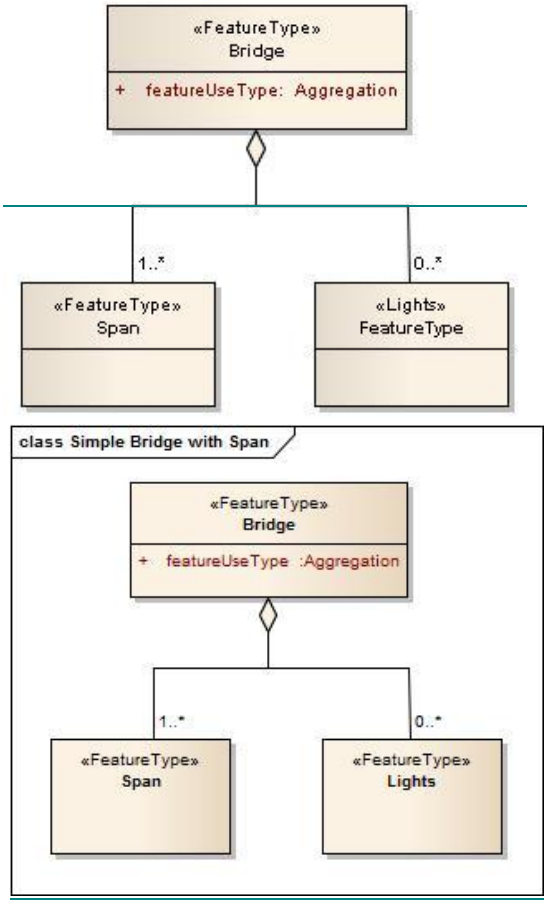


Figure 2 - Aggregation

4.3.3.3 Composition

A composition is a strong aggregation. In a composition, if a container object is deleted then all of its containee objects are deleted as well.

EXAMPLE If a feature type of TSS is deleted, then all of its component feature types that make up the TSS are deleted.

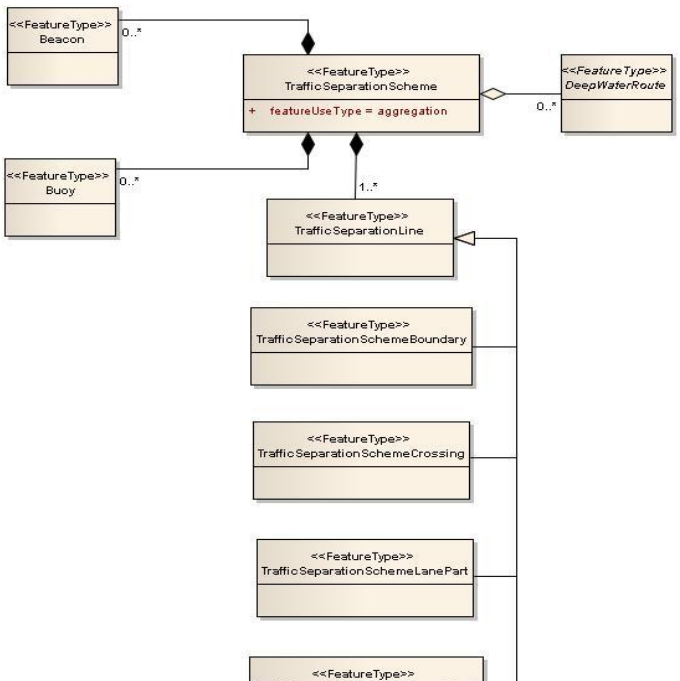


Figure 3 - Composition

4.3.4 Information Types

Information types are identifiable pieces of information in a dataset that can be shared between other features. They have attributes but have no relationship to any geometry; information types may reference other information types.

4.3.4.1 Spatial Quality

Spatial quality attributes are carried in an information class called **Spatial quality**. Only points, multipoints and curves can be associated with Spatial quality. Currently no use case for associating surfaces with spatial quality attributes is known, therefore this is prohibited. Vertical uncertainty is prohibited for curves as this dimension is not supported by curves.

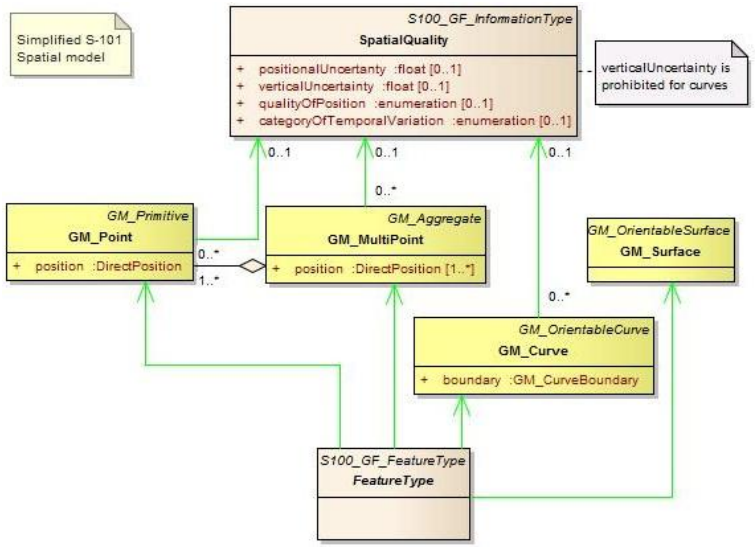


Figure 4 - Spatial Information Type

4.3.5 Attributes

S-101 defines attributes as either simple or complex.

4.3.5.1 Simple Attributes

S-101 uses eight types of simple attributes; they are listed in the following table:

Type	Definition
Boolean	the value is a logical value either 'True' or 'False'
Integer	the value is an integer number
Real	the value is a floating point number
enumeration	the value is one of a list of predefined values.
text	the value is general text. This is also defined as CharacterString.
dateTime	the value marks a point in time, consisting of a date in the Gregorian calendar and a 24 hour time. The time may contain a time zone.
date	the value is a date according to the Gregorian calendar.
time	the value is a 24 hour time, It may contain a time zone.

Table 2 - Simple Attribute Types

4.3.5.2 Complex Attributes

Complex attributes are aggregations of other attributes that are either simple or complex. The aggregation is defined by means of attribute bindings.

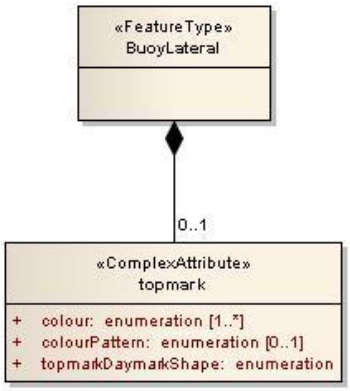


Figure 5 - Complex Attribute

EXAMPLE In this example a **topmark** has three sub attributes. The Buoy Lateral Feature may optionally include one instance of the complex attribute **topmark**.

4.4 Feature Object Identifier

Each real world feature within an ENC must have a unique universal Feature Object Identifier. This identifier, called the feature object identifier, is formed by the binary concatenation of the contents of the subfields of the "Feature Object Identifier" [FOID] field. Information types must not have a FOID.

The FOID may be used to identify that the same feature has instances in separate datasets. For example the same feature included in different maximum display scale datasets, or a feature being split by the ENC dataset limits within the same maximum display scale.

FOIDs must not be repeated in a dataset. Where a real-world feature has multiple parts within a single ENC dataset due to ENC dataset limit truncations, the feature will reference each spatial part of the feature within the cell. This is accomplished in the 8211 encoding by including a Spatial Association for each disjoint component. When a feature's geometry is split each component must be represented by a separate spatial object that the feature refers to.

Where a real-world feature is repeated in datasets of different maximum display scale, the FOID should be repeated for each instance of the feature across the maximum display scale range. Where this occurs, all instances of the geo feature must be identical, i.e. same feature class and attribute values.

Feature Object Identifiers must not be reused by another feature, even when a feature has been deleted. The same feature can be deleted and added again later using the same FOID.

4.5 Dataset

4.5.1 Introduction

A Data Set is a grouping of features, attributes, geometry and metadata which comprises a specific coverage. A data set can contain more than one **DataCoverage**. The data boundary is defined by the extent of the **DataCoverage** features and must be contained within the **boundingBox**.

NOTE: Annex CXX.X provides guidance for ENC producers regarding how to create datasets with multiple **DataCoverages.**

Data Sets with the same maximum display scale may overlap, however **DataCoverage** features within these datasets must not overlap. This rule applies even if several producers are involved. There must be no overlapping data of the same maximum display scale, except at the agreed adjoining national data limits, where, if it is difficult to achieve a perfect join, a 5 metre overlapping buffer zone may be used; and for this situation, there must be no gaps in data.

In order to facilitate the efficient processing of ENC data the geographic coverage of a given maximum display scale must be split into data sets. Each data set must be contained in a physically separate, uniquely identified file on the transfer medium.

An ENC update data set must not change the limit of data coverage for the base ENC dataset. Where the limit of data coverage for a base ENC dataset is to be changed, this must be done by issuing a new edition of the dataset.

Datasets must not cross the 180° meridian, this includes both the **DataCoverage** features and the **boundingBox**.

4.5.1.1 Dataset size

Datasets must not exceed 10MB.

Updates should not normally be larger than 50kb and must not be larger than 200kb.

4.6 Display Scale Range

Display scales are used to indicate a range of scales between which a producer considers the data is intended for use. The smallest scale is defined by the **minimumDisplayScale** and the largest scale by the **maximumDisplayScale**. These scales must be set at one of the scales specified in clause 3 (spatial resolutions).

The **DataCoverage** area features carry the scale attribution within the data set. The discovery metadata must list all the **DataCoverage** area features contained within that dataset and their assigned **mimimumDisplayScale** and **maximumDisplayScale**.

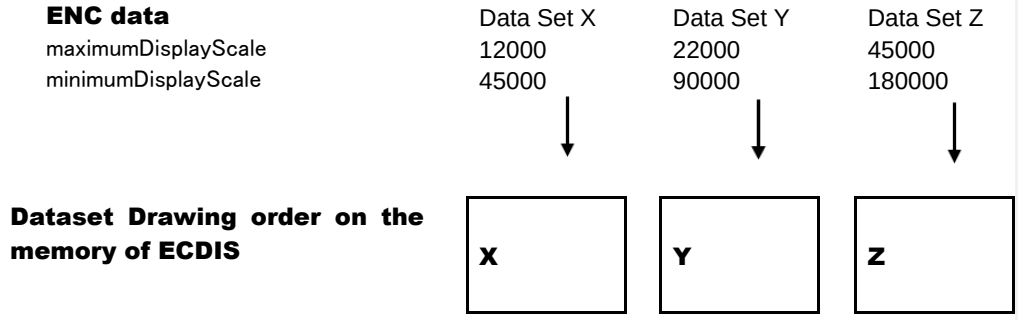
Commentaire [J2]: TSMAD: This needs to be reworded to comply to what the discovery metadata says. It should not say features. Need to decide how the data should be structured and then figure out how to do the metadata.

4.7 Dataset Loading and Unloading

ENCs form a seamless coverage in ECDIS which covers different areas with different scales of data. In order for the appropriate ENC to be viewed at the mariners selected viewing scale, S-101 prescribes an algorithm for the loading and unloading of ENCs within an ECDIS.

4.7.1 Dataset Loading and Unloading Algorithm

This clause defines the dataset loading and unloading algorithm for use on ECDIS.



Condition		Combining Datasets
1	Mariners Selected Viewing Scale (MSVS) = 45000 maximumDisplayScale(X,Y,Z) <= MSVS <= minimumDisplayScale(X,Y,Z)	**X** + **Y** + **Z**
2	MSVS = 90000 maximumDisplayScale(Y,Z) <= MSVS <= minimumDisplayScale(X)	**Y** + **Z**
3	MSVS = 22000 maximumDisplayScale(X,Y) <= MSVS < maximumDisplayScale(Z)	**X** + **Y** + **Z** + **Overscale indication of Z**

* Dataset with the smaller **maximumDisplayScale** is drawn first.

Figure 6 - Data Loading and Unloading Algorithm

In order for ECDIS to properly load and unload data as the mariner is zooming in and out using the mariners selected viewing scale (MSVS) the following algorithm must be used.

1. Create selection List

a. All **DataCoverage** areas within the graphics window within scale range (covered by the MSVS) are firstly ordered by **maximumDisplayScale** and secondly by the largest percentage of coverage if **DataCoverage** areas have the same **maximumDisplayScale**

b. All other smaller scale **DataCoverage** areas within the graphics window are firstly ordered by **maximumDisplayScale** and secondly by the largest percentage of coverage if **DataCoverage** areas have the same **maximumDisplayScale**

c. The display order is from the smallest **maximumDisplayScale** to the largest **maximumDisplayScale**, i.e. the **DataCoverage** area with largest **maximumDisplayScale** will be displayed with the highest priority

2. If the MSVS is larger than the **maximumDisplayScale** of an area within the window, turn on overscale indication.

3. If the mariner selects an individual dataset to load it must be displayed at its maximumDisplayScale, i.e. MSVS is set to the **maximumDisplayScale** of the selected dataset, and then the algorithm is used to fill the graphics window.

The example below works through four scenarios and uses four different types of **DataCoverage** with different **maximumDisplayScale** and **minimumDisplayScale**. They are denoted as areas A, B, C and D.

NOTE: this example is applicable to multiple datasets with overlapping **DataCoverages**.

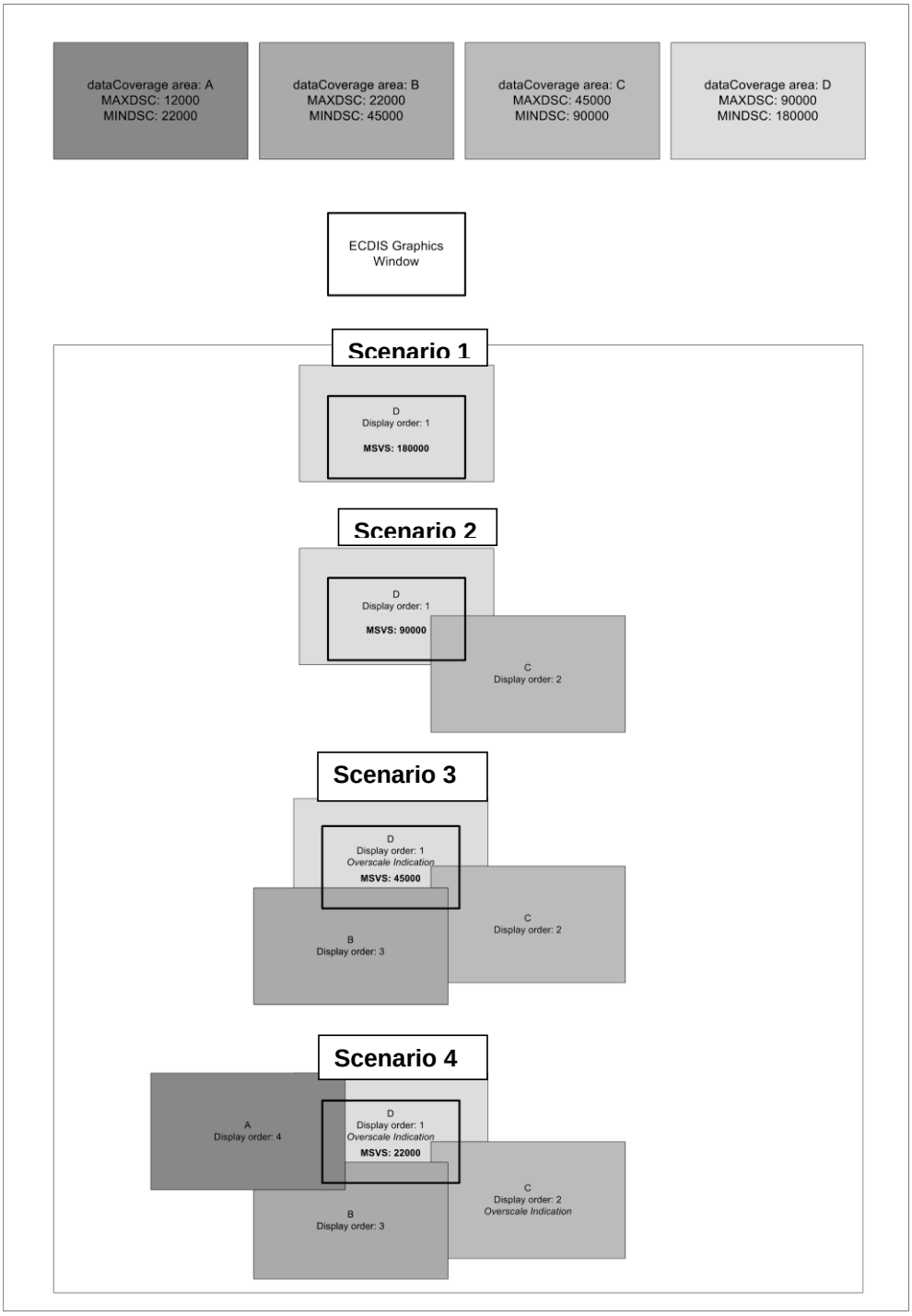


Figure 7 - Data loading and unloading scenarios

Scenario 1:

Mariners Selected Viewing Scale (MSVS) = 1:180,000

DataCoverage area D must display as the appropriate coverage.

Scenario 2:

MSVS = 1:90,000

The ECDIS graphics window will zoom in and pick up larger scale coverage within the window – **DataCoverage** area C, in addition to displaying area D. As **DataCoverage** area C has a better scale range the display of this **DataCoverage** takes priority over area D.

Scenario 3:

MSVS = 1:45,000,

The ECDIS graphics window will zoom in and pick up larger scale coverage within the window – area B, in addition displaying area C and D. As **DataCoverage** for area B has a better scale range the display of this **DataCoverage** takes priority over area C and D. The display order for this scenario is Area D is on the bottom, followed by Area C and then Area B. However, as the MAXDSC for area D (90,000) falls outside of the MSVS – area D must display the overscale indication.

Scenario 4:

MSVS = 1:22,000

The ECDIS graphics window will zoom in and pick up the larger scale coverage within the window – area A, in addition to displaying area B, C and D. As **DataCoverage** for area A has a better scale range the display of this **DataCoverage** takes priority over area B, C and D. The display order for this scenario is Area D is on the bottom, followed by Area C, B and then A. However, as the MAXDSC for area D (90,000) and Area C (45,000) falls outside of the MSVS – area D and C must display the overscale indication.

The mariners selected viewing scale (MSVS) is the user selected scale in the ECDIS.

4.8 Geometry

4.8.1 S-100 Level 3a Geometry

The underlying geometry of an ENC is constrained to level 3a which supports 0, 1 and 2 dimensional objects (points, curves and surfaces) as defined by S-100 Part 7 – Spatial Schema.

Level 3a is described by the following constraints:

- Each curve must reference a start and end point (they may be the same).
- Curves must not self intersect. See Figure 8.
- Areas are represented by a closed loop of curves beginning and ending at a common point.
- In the case of areas with holes, all internal boundaries must be completely contained within the external boundary and the internal boundaries must not intersect each other or the external boundary. Internal boundaries may touch tangentially (i.e. at one point). See Figure 9.

- The outer boundary of a surface must be in a clockwise direction (surface to the right of the curve) and the curve orientation positive. The inner boundary of a surface must be in a counter-clockwise direction (surface to the right of the curve) and the curve orientation negative. See Figure 10.

S-101 further constrains Level 3a with the following:

- Coincident linear geometry must be avoided when there is a dependency between features.
- The interpolation of GM_CurveSegment must be loxodromic.
- Linear features must not be encoded with a distance between two consecutive vertices which is smaller than 0.3mm at maximum display scale.

The following exception applies to S-101:

- The use of coordinates is restricted to two dimensions, except in the case of soundings which use GM_Point or GM_Multipoint with three dimensional coordinates.

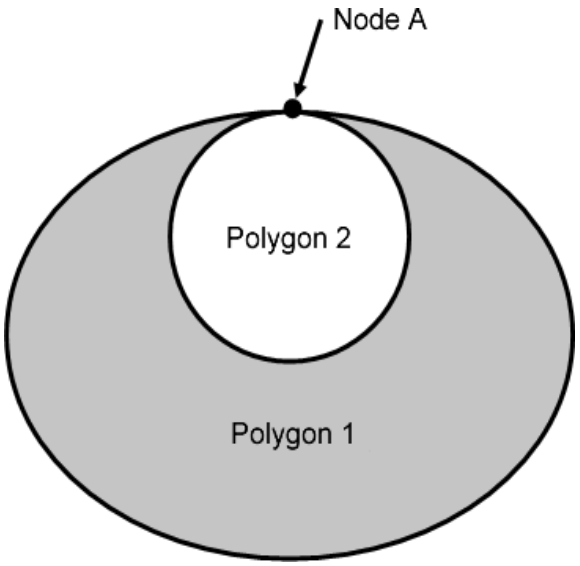


Figure 8 - Self Intersect Example

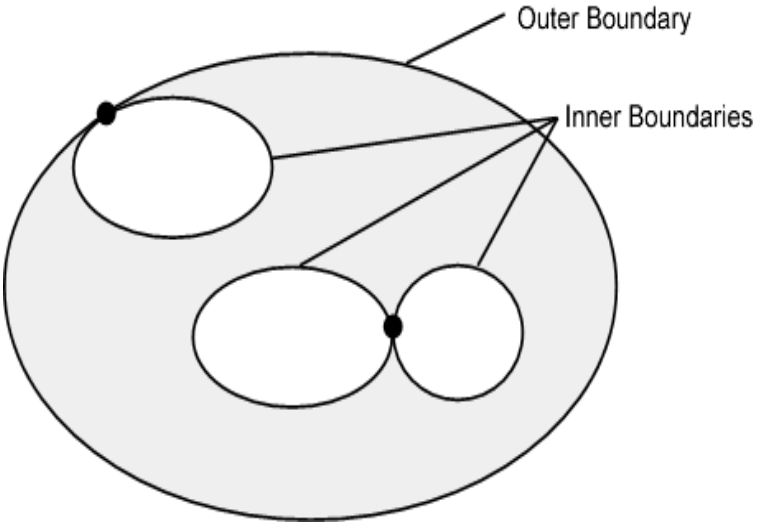


Figure 9 - Area Holes

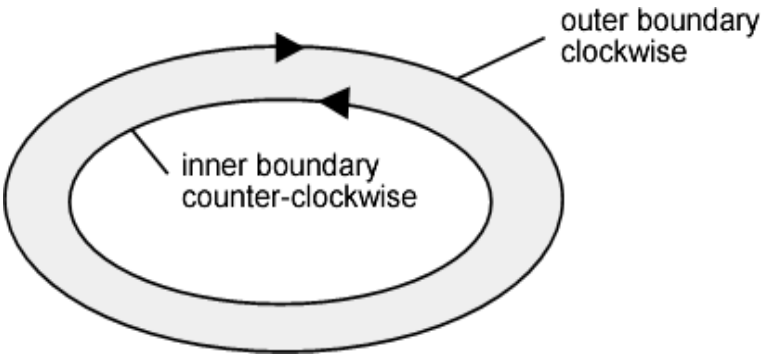


Figure 10 - Boundary Direction

4.8.2 Masking

In certain circumstances, the symbolisation of an edge may need to be suppressed. This is done using the Masked Spatial Type [MASK] field of the Feature Type record. The Mask Update Instruction [MUIN] must be set to {1} and Referenced Record name [RRNM] and Referenced Record identifier [RRID] fields must be populated with the values of the referenced spatial record. The Mask Indicator [MIND] must be set to either {1} or {2} (see Annex B – clause B1.5.13)

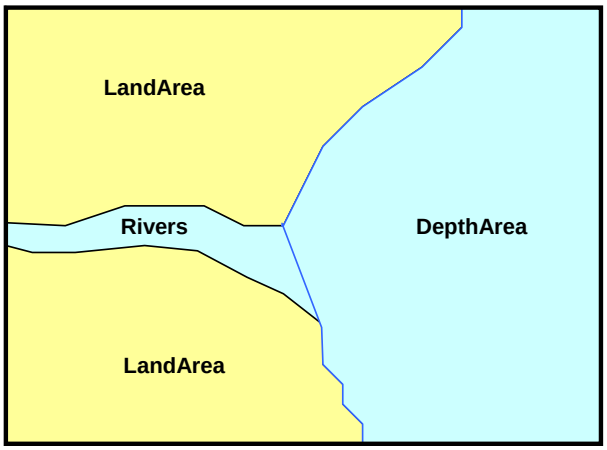


Figure 11 - Example without Masking

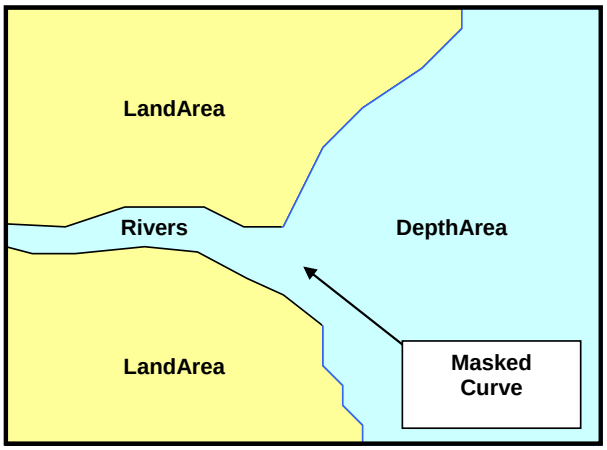


Figure 12 - Example of masked edge between Rivers and Depth Area features, where the River should be masked. In this example MIND is set to {2} – supress portrayal

5 Coordinate Reference Systems (CRS)

5.1 Introduction

When describing geographic information it is common practice to separate the horizontal and vertical part of a position. This leads to 2D Coordinate Reference Systems for the horizontal positions and 1D Coordinate Reference Systems for the vertical positions. To describe 3D coordinates those Coordinate Reference Systems must be combined to produce a compound Coordinate Reference System. An ENC data set must define at least one compound CRS. An ENC compound CRS is composed of 2D geodetic CRS (WGS84) and a vertical CRS.

5.2 Horizontal Coordinate Reference System

For ENC the horizontal CRS must be EPSG:4326 (WGS84). The full reference to EPSG: 4326 can be found at www.epsg-registry.org.

5.3 Vertical CRS for Soundings

Although all coordinates in a data set must refer to the same horizontal CRS different Vertical Datums can be used for the depth component of a coordinate tuple. Therefore the vertical CRS can be repeated. For each Vertical CRS a unique identifier is defined. Those identifiers will be used to indicate which Vertical CRS is used. Units must be in metres.

In S-101 depths are represented by positive values down and negative values for intertidal soundings (drying heights).

Although all coordinates in a data set must refer to the same CRS different Vertical Datums can be used for the height or depth component of a coordinate tuple. Therefore the VDAT field can be repeated. For each Vertical Datum a unique identifier is defined. Those identifiers will be used in the 3D - coordinate fields to indicate which Vertical Datum is used. The encoding of the Coordinate Reference System record will be demonstrated with two examples. The first example specifies a compound CRS. The first component is a 2D Geographic CRS (WGS84) and the second component is a Vertical CRS for depth using the Vertical Datum: Mean Sea Level.

```
CSID: RCNM{15}!RCID{1}!NCRC{2}!
CRSH: CRIX{1}!CRST{1}!CSTY{1}!CRNM'WGS
      84'!CRSI'4326'!CRSS{2}!SCRI!
CRSH: CRIX{2}!CRST{5}!CSTY{3}!CRNM'Mean Sea Level Depth'!
      CRSI!CRSS{255}SCRI!
CSAX: AXTY{12}!AXUM{4}!
VDAT: DTNM'Mean Sea Level'!DTID'VERDAT3'!DTSR{2}!SCRI!
```

The second example encodes a projected CRS by defining the details

```
CSID: RCNM{15}!RCID{1}!NCRS{1}!
CRSH: CRIX{1}!CRST{4}!CSTY{2}!CRNM'WGS84/UTM
      32N'!CRSI!CRSS{255}SCRI!
CSAX: AXTY{4}!AXUM{4}!AXTY{5}!AXUM{4}!
PROJ: PROM{2}!PRP1{0}!PRP2{9}!PRP3{0.9996}!PRP4{0}!PRP5{0}!
      FEAS{500000}!FNOR{0}!
GDAT: DTNM'World Geodetic System 1984'!ELNM'WGS 84'!ESMA{6378137}!
      ESPT{2}!ESPM{298.257223563}!CMNM'Greenwich'!CMGL{0}!
```

6 Data Quality

6.1 Introduction

Data Quality is considered to be meta information and for S-101 it is divided into two parts. The first part is overall data quality for the product and the second is data quality of the bathymetric, non-bathymetric and survey information within the product.

6.1.1 Overall Data Quality

For S-101, the data must be validated using S-58 Recommended ENC Validation Checks for the S-101 product specification. Overall data quality for an S-101 ENC should cover the following: completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy, and anything specifically required for the product being specified.

6.1.2 Bathymetric Data Quality

Bathymetric data quality comprises the following:

completeness of data (e.g. seafloor coverage).
currency of data (e.g. temporal degradation);
uncertainty of data;
source of data;

Data quality is considered to be meta information. As such, it can be encoded at three different levels (dataset, meta feature area, feature instance). All positional (2D), vertical (1D), horizontal distance (1D) and orientation (1D) uncertainty attributes concern the 95% confidence level of the variation associated with all sources of measurement, processing and visualization error. Uncertainty due to temporal variation should not be included in these attributes.

The meta feature for Bathymetric data quality is: **QualityOfBathymetricData**,

6.1.3 Non Bathymetric Data Quality

The meta feature **QualityOfNonbathymetricData** allows for data quality to be expressed for non bathymetric items.

6.1.4 Survey Data Quality

Quality of the surveys that originated these items can be further expressed in **QualityOfSurvey**. **QualityOfSurvey** can apply to bathymetry (e.g. underwater rock), non-bathymetry (e.g. navigational aids) and a combination of these (e.g. lidar survey).

7 Data Capture and Classification

7.1 Introduction

The S-101 ENC Data Classification and Encoding Guide (DCEG) describes how data describing the real world should be captured using the types defined in the S-101 Feature Catalogue. This Guide is located in Annex A.

S-101 datasets must conform to all mandatory elements of the ENC DCEG where the word 'must' is used.

8 Maintenance

8.1 Introduction

This clause describes the maintenance process for datasets, source, production process and how feature and portrayal catalogues are to be managed within an S-100 ECDIS.

8.2 Maintenance and Update Frequency

Datasets are maintained as needed and must include mechanisms for ENC updating designed to meet the needs of the mariner regarding safety of navigation.

8.3 Data Source

Data Producers must use applicable sources to maintain and update data and provide a brief description of the sources that were used to produce the dataset.

8.4 Production Process

Data Producers should follow their established production processes for maintaining and updating datasets. Data is produced against the DCEG, checked against S-58 and encapsulated in ISO/IEC 8211.

Only datasets that conform to the mandatory requirements outlined in S-101 will be considered an ENC.

8.5 Feature and Portrayal Catalogue Management

For each new version of the S-101 Product Specification a cumulative feature and portrayal catalogue will be released. This will allow the ECDIS to only have to manage a single feature and portrayal catalogue that are compatable with different datasets that compliant to different versions of the product specification.

See the Implementation Guidance Annex for specific rules.

9 Portrayal

9.1 Introduction

The display of features contained in an S-101 dataset is determined by the symbology and portrayal rules contained in the S-101 Portrayal Catalogue.

The S-101 Portrayal Catalogue will be available in an XML document which conforms to the S-100 XML Portrayal Catalogue Schema. The S-101 Portrayal Catalogue is available from the IHO website.

Item Name	Description	M/O	Card	type
portrayalLibraryCitation	Bibliographic reference to the portrayal library	O	0..1	CI_Citation (ISO 19115)

NOTE: IT SHOULD CONTAIN THE PORTRAYAL CATOLUE STRUCTURE – SIMILAR TO CLAUSE FOUR OF THIS DOCUMENT. It may also contain pieces of S-52 that are still needed (both here or in the implementation guidance annex).

10 Data Product format (encoding)

10.1 Introduction

This clause specifies the encoding for S-101 datasets. See Annex B for a complete description of the data records, fields and subfields defined in the encoding.

Format Name: ISO/IEC 8211

Character Set: ISO 10646 Base Multilingual Plane

Specification: S-100 profile of ISO/IEC 8211 (part 10A)

10.1.1 Encoding of Latitude and Longitude

Coordinates are stored as integers. Latitude and longitude are converted to integers using a multiplication factor held in the Data Set Structure Information field under [CMFX] and [CMFY] (see Annex B – clause B1.6.3).

These coordinate multiplication factors must be set to {10000000} (10^7) for all datasets.

EXAMPLE A longitude = 42.0000 is converted into X = longitude * CMFX = 42.0000 * 10000000 = 420000000.

10.1.2 Encoding of Depths

Depths are converted from decimal metres to integers by means of the [CMFZ] (see Annex B – clause B1.6.3). This product limits the resolution to two decimal places and therefore the [CMFZ] must be set to {100}.

10.1.3 Numeric Attribute Encoding

Floating point or integer attribute values must not be padded by non-significant zeroes.

10.1.4 Text Attribute Values

Character strings must be encoded using the character set defined in ISO 10646-1, in Unicode Transformation Format-8 (UTF-8). A BOM (byte order mark) must not be used

10.1.5 Mandatory Attribute Values

There are four reasons why attribute values may be considered mandatory:

- They determine whether a feature is in the display base,
- Certain features make no logical sense without specific attributes,
- Some attributes are necessary to determine which symbol is to be displayed,
- Some attributes are required for safety of navigation.

All mandatory attributes are identified in the Feature Catalogue and summarised in Annex A – Data Classification and Encoding Guide.

10.1.6 Missing Attribute Values

In a base data set, when an attribute code is present but the attribute value is missing, it means that the producer wishes to indicate that this attribute value is unknown.

In an update data set, when an attribute code is present but the attribute value is missing it means:

- that the value of this attribute is to be replaced by an unknown value if it was present in the original data set,
- that an unknown value is to be inserted if the attribute was not present in the original data set.

11 Data Product Delivery

11.1 Introduction

This clause specifies the encoding and delivery mechanisms for an S-101 ENC. Data which conforms to this product specification must be delivered by means of an exchange set.

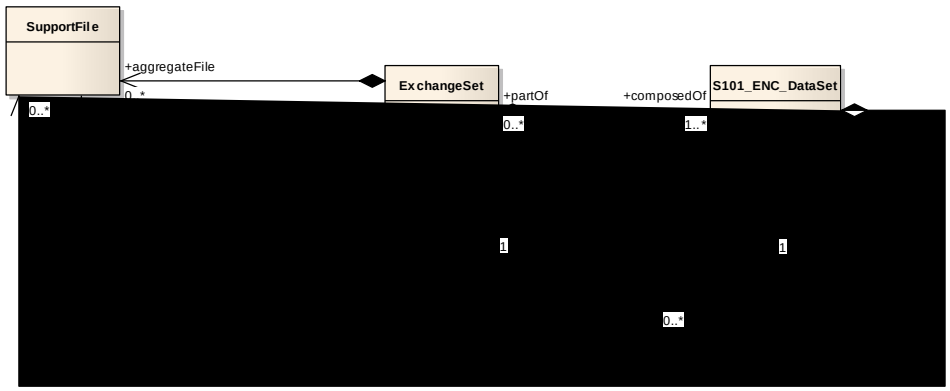


Figure 13 - Exchange Set Structure

11.2 Exchange Set

S-101 datasets are grouped into exchange sets. Each exchange set consists of one or more ENC datasets with an associated XML metadata file and a single Exchange Catalogue XML file containing metadata. It may also include one or more support files.

Units of Delivery: Exchange Set

Transfer Size: Unlimited

Medium Name: Digital data delivery

Other Delivery Information:

Each exchange set has a single exchange catalogue which contains the discovery metadata for each dataset and references to any support files.

Support files are supplementary information which are linked to the features by the following fields within the dataset.

- textualDescription
- graphicalRepresentation

An exchange set is encapsulated into a form suitable for transmission by a mapping called an encoding. An encoding translates each of the elements of the exchange set into a logical form suitable for writing to media and for transmission online. An encoding may also define other elements in addition to the exchange set contents (i.e media identification, data extents etc…) and also may define commercial constructs such as encryption and compression methods.

If the data is transformed in S-101 it must not be changed.

This product specification defines the encoding which must be used as a default for transmission of data between parties.

The encoding encapsulates exchange set elements as follows:

Mandatory Elements

ENC datasets – ISO 8211 encoding of features/attributes and their associated geometry and metadata.

Exchange Catalogue – the XML encoded representation of exchange set catalogue features [discovery metadata]. It also includes an additional file level CRC check per dataset.

Optional Elements

Supplementary files – These are contained within the exchange set as files and the map from the name included within the dataset and the physical location on the media is defined within the Exchange Catalogue.

S-101 Feature Catalogue – If it is necessary to deliver the latest feature catalogue to the end user it may be done using the S-101 exchange set mechanism for datasets

S-101 Portrayal Catalogue - If it is necessary to deliver the latest portrayal catalogue to the end user it may be done using the S-101 exchange set mechanism for datasets.

11.3 Dataset

11.3.1 Datasets

Four types of dataset files may be produced and contained within an exchange set:

- Update: Changing some information in an existing data set. The encoding structure for an update is located in Annex B1.6

- re-issue of a dataset : including all the updates applied to the original data set up to the date of the reissue. A re-issue does not contain any new information additional to that previously issued by updates. The encoding structure is located in Annex B1.5

- New dataset and new edition of a dataset: Including new information which has not been previously distributed by updates. Each new edition of a data set must have the same name as the data set that it replaces. A new edition can also be ENC data that has previously been produced for this area and at the same maximum display scale. The encoding structure is located in Annex B1.5

- Cancellation: The dataset is cancelled and is deleted from the ECDIS. The encoding structure for a cancellation file is located in Annex B1.7

11.3.2 Dataset file naming

CCXXXXXXXX.EEE

The main part forms an identifier where:
- CC - the first two characters identify the issuing agency.
- the third to tenth characters are optional and may be used in any way by the producer to provide the unique file name. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).
- .EEE – new editions and re-issues use 000, updates start at 001 and increment until a limit of 999.
- The minimum number of characters in a dataset name is three and the maximum number is ten.

Each re-issue or new edition of a dataset must have the same name as the base dataset which it replaces.

11.3.3 New Editions, Re-Issues, Updates and Cancellations

This section defines the sequencing of S-101 datasets for New Editions, Updates and Re-issues. In order to ensure that feature type updates are incorporated into an ECDIS in the correct sequence without any omission, a number of parameters encoded in the data are used in the following way:

edition number when a data set is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition.

update number update number 0 is assigned to a new data set and a new edition. The first update dataset file associated with this new data set must have update number 1. The update number must be increased by one for each consecutive update, until a new edition is released.

Re-issue number A re-issue of a data set must have the update number of the last update applied to the dataset, and use the same extension as the base dataset.

update comment comment for describing the change introduced by an update.

issue date date up to which the data producer has incorporated all applicable changes. The issue date must be greater than the previous issue date of the dataset.

In order to cancel a data set, an update dataset file is created for which the edition number must be set to 0. This message is only used to cancel a base dataset file. Where a dataset is cancelled and its name is reused at a later date, the issue date must be greater than the issue date of the cancelled dataset. When the dataset is cancelled it must be removed from the system.

An exchange set may contain base dataset files and update dataset files for the same datasets. Under these circumstances the update dataset files must follow on in the correct sequential order from the last update applied to the base dataset file.

11.4 Support Files

Data set support files offer supplementary information that can be included in an ENC exchange set.

Text files must contain only general text as defined by this standard. (Extensible mark-up language (XML) supports UTF-8 character encoding). **(TXT), (XML), (HTM)**

Picture files must be in TIFF 6.0 specification ***(TIFF)***

.EEE – support file extension

File Types	Extensions	Comment
Text	TXT	
	HTM	HTML files must only include inline or embedded Cascading Style Sheet (CSS) information and must not embed Javascript or other dynamic content e.g. DHTML, Flash etc.
	XML	XML documents must only be included in accordance with guidance provided within the Data Classification and Encoding Guide. This may include a schema for the validation of XML documents.
Picture	TIF	Baseline TIFF 6.0

11.4.1 Support File Naming

All support files must have unique universal file identifiers. The file identifier of support information should not be used to describe the physical content of the file. The support file metadata that accompanies the file will inform the user of the name and purpose of the file (i.e. new, replacement and deletion).

In this encoding the support files are named according to the specifications given below:

CCXXXXXXXX.EEE

The main part forms an identifier where:

- the first two characters identify the issuing agency.

- the third to tenth characters can be used in any way by the producer to provide the unique file name. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).
- .EEE – support file extension. (TXT, HTM, XML or TIF)

11.4.2 Support File Management

When a support file is created or a subsequent version is issued it must carry an issue date and a CRC value calculated on the content. These values are contained in the Support File Metadata as defined in clause 12.1.2 and must not change while the file is still current.

The type of support file is indicated in the "purpose" field of the discovery metadata. Support files carrying the "deletion" flag may be removed from the ECDIS. When a feature pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the ECDIS software must check to see whether any other feature referenced the same file, before that file is deleted.

Support files should be stored in a separate folder within the exchange set.

11.5 Exchange Catalogue

The exchange catalogue acts as the table of contents for the exchange set. The catalogue file of the exchange set must be named CATALOG.101. No other file in the exchange set may be named CATALOG. The contents of the exchange catalogue are described in Clause 12.

11.6 Data integrity

11.6.1 ENC data integrity measures

Where there is a high impact on the integrity of data as a result of data corruption, such as to ENC data, there is a need for a mechanism within the ENC data itself to ensure it has not changed during transmission/delivery. The mechanism chosen for this assurance is a Cyclic Redundancy Check (CRC). File integrity checks are based on the CRC-32 algorithm (a 32 bit Cyclic Redundancy Check algorithm) as defined in ANSI/IEEE Standard 802.3, the reference for which is given in clause 1.2.

11.6.2 Processing

Encoding is defined by the following generating polynomial:

$$G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^{8} + x^{7} + x^{5} + x^{4} + x^{2} + x + 1$$

Processing is applied to relevant files as they appear in the exchange set.

The CRC value of the file is defined by the following process:
1. The first 32 bits of the data are complemented.
2. The n bits of the data are then considered to be the coefficients of a polynomial M(x) of degree n-1.
3. M(x) is multiplied by x^{32} and divided by G(x), producing a remainder R(x) of degree <31.
4. The coefficients of R(x) are considered to be a 32-bit sequence.
5. The bit sequence is complemented and the result is the CRC.

The hexadecimal format of CRCs are converted to ASCII characters and stored in the “Catalogue Directory” [CATD] field.

12 Metadata

12.1 Introduction

For information exchange, there are several categories of metadata required: metadata about the overall exchange catalogue, metadata about each of the datasets contained in the catalogue, and metadata about the support files that make up the package.

This clause defines the mandatory and optional metadata needed for S-101. In some cases the metadata may be repeated in a national language. If this is the case it is noted in the Remarks column.

Figures 14 to 16 outline the overall concept of an S-101 exchange set for the interchange of geospatial data and its relevant metadata. Figure 1 depicts the realization of the ISO 19139 classes which form the foundation of the exchange set. The overall structure of S-101 metadata for exchange sets is modelled in Figure 15. More detailed information about the various classes is shown in Figure 16 and a textual description in the tables at clause 12.3.

The discovery metadata classes have numerous attributes which enable important information about the datasets and accompanying support files to be examined without the need to process the data, e.g. decrypt, decompress, load etc. Other catalogues can be included in the exchange set in support of the datasets such as feature, portrayal, coordinate reference systems, code lists etc. The attribute “purpose” of the support file metadata provides a mechanism to update support files more easily.

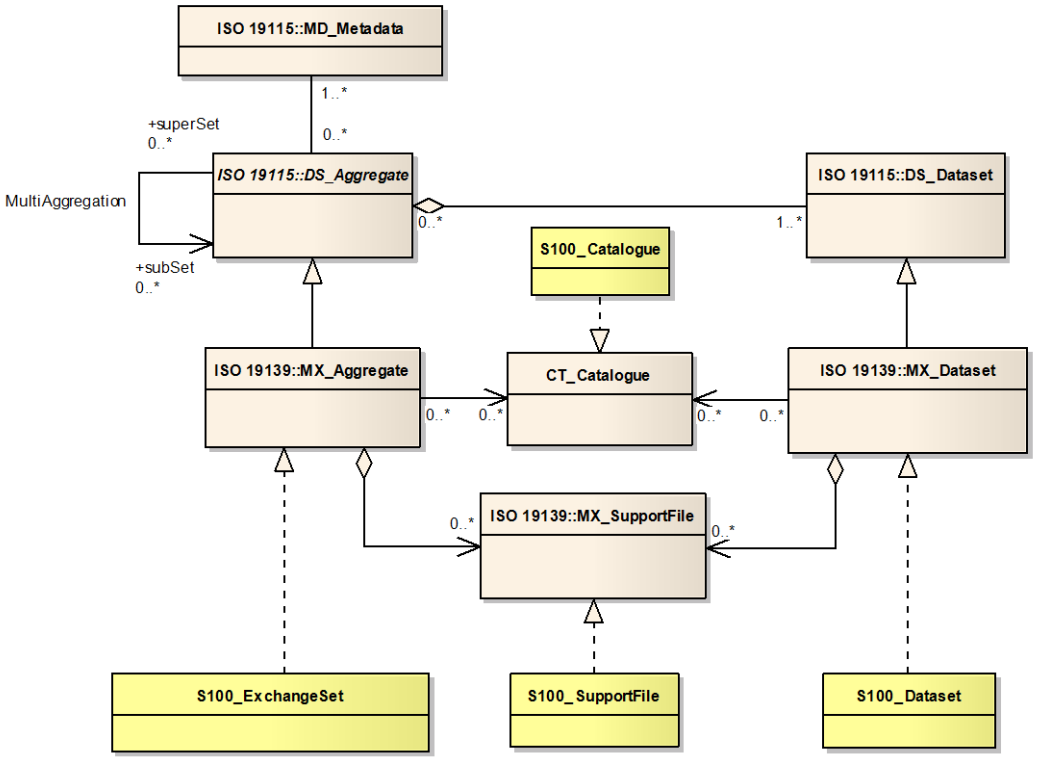


Figure 14 Realization of the Exchange Set Classes

Commentaire [J3]: Change this graphic to show the realization from S-100 to S-101

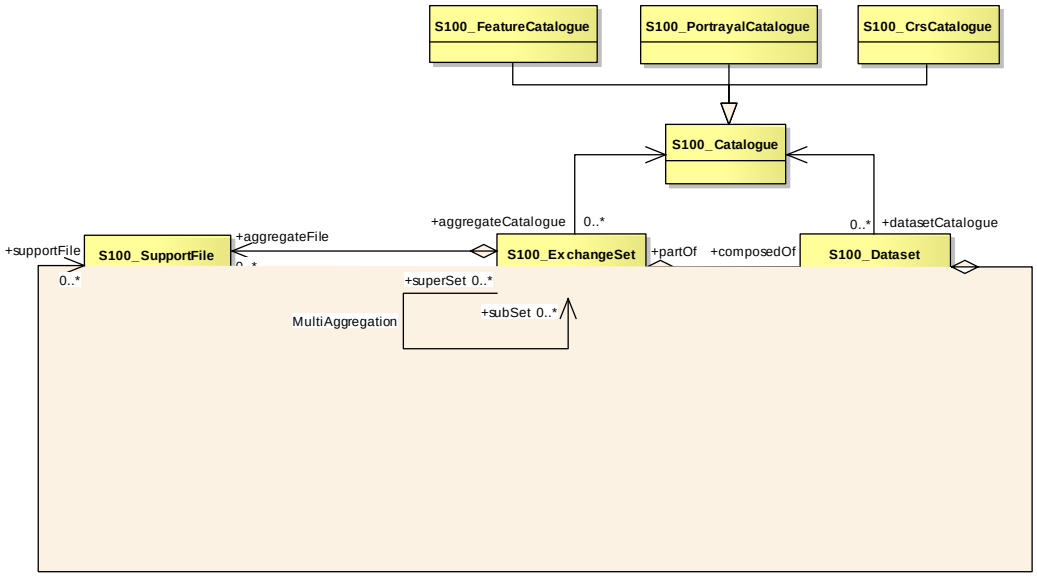
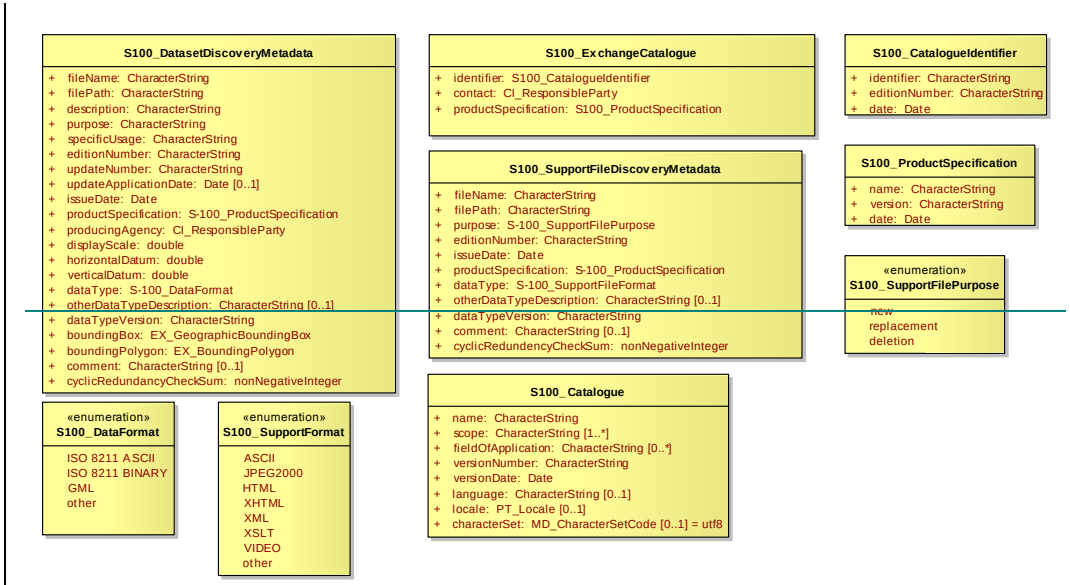


Figure 15 – S-101 ExchangeSet

Commentaire [JLP4]: Update Graphic


S100_DatasetDiscoveryMetadata
+ fileName: CharacterString
+ filePath: CharacterString
+ description: CharacterString
+ purpose: CharacterString
+ specificUsage: CharacterString
+ editionNumber: CharacterString
+ updateNumber: CharacterString
+ updateApplicationDate: Date [0..1]
+ issueDate: Date
+ productSpecification: S-100_ProductSpecification
+ producingAgency: CI_ResponsibleParty
+ displayScale: double
+ horizontalDatum: double
+ verticalDatum: double
+ dataType: S-100_DataFormat
+ otherDataTypeDescription: CharacterString [0..1]
+ dataTypeVersion: CharacterString
+ boundingBox: EX_GeographicBoundingBox
+ boundingPolygon: EX_BoundingPolygon
+ comment: CharacterString [0..1]
+ cyclicRedundancyCheckSum: nonNegativeInteger
«enumeration»
S100_DataFormat
ISO 8211 ASCII
ISO 8211 BINARY
GML
other
«enumeration»
S100_SupportFormat
ASCII
JPEG2000
HTML
XHTML
XML
XSLT
VIDEO
other
S100_ExchangeCatalogue
+ identifier: S100_CatalogueIdentifier
+ contact: CI_ResponsibleParty
+ productSpecification: S100_ProductSpecification
S100_SupportFileDiscoveryMetadata
+ fileName: CharacterString
+ filePath: CharacterString
+ purpose: S-100_SupportFilePurpose
+ editionNumber: CharacterString
+ issueDate: Date
+ productSpecification: S-100_ProductSpecification
+ dataType: S-100_SupportFileFormat
+ otherDataTypeDescription: CharacterString [0..1]
+ dataTypeVersion: CharacterString
+ comment: CharacterString [0..1]
+ cyclicRedundancyCheckSum: nonNegativeInteger
S100_Catalogue
+ name: CharacterString
+ scope: CharacterString [1..*]
+ fieldOfApplication: CharacterString [0..*]
+ versionNumber: CharacterString
+ versionDate: Date
+ language: CharacterString [0..1]
+ locale: PT_Locale [0..1]
+ characterSet: MD_CharacterSetCode [0..1] = utf8
S100_CatalogueIdentifier
+ identifier: CharacterString
+ editionNumber: CharacterString
+ date: Date
S100_ProductSpecification
+ name: CharacterString
+ version: CharacterString
+ date: Date
«enumeration»
S100_SupportFilePurpose
new
replacement
deletion

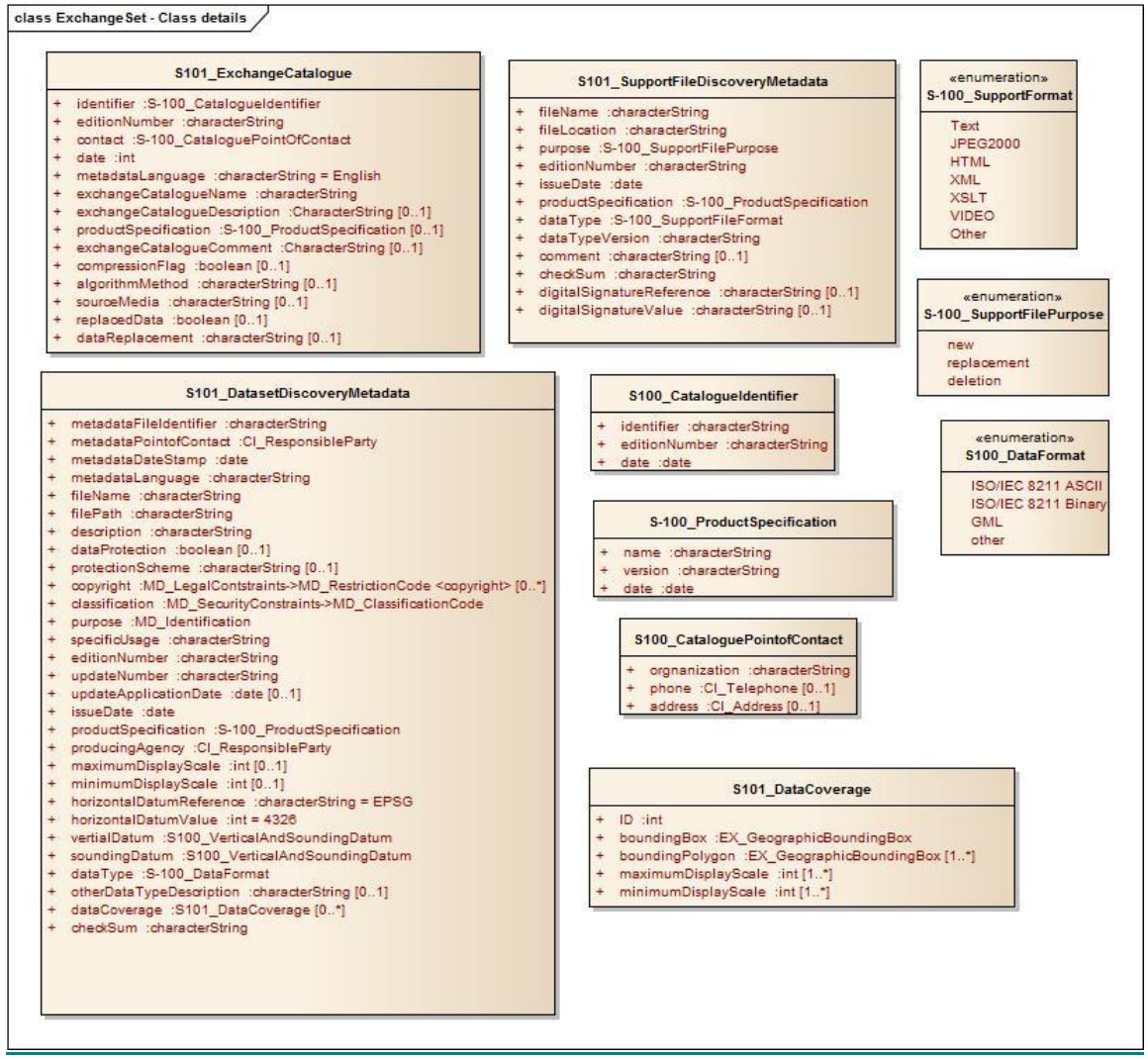

class ExchangeSet - Class details
S101_ExchangeCatalogue
+ identifier :S-100_CatalogueIdentifier
+ editionNumber :characterString
+ contact :S-100_CataloguePointOfContact
+ date :int
+ metadataLanguage :characterString = English
+ exchangeCatalogueName :characterString
+ exchangeCatalogueDescription :CharacterString [0..1]
+ productSpecification :S-100_ProductSpecification [0..1]
+ exchangeCatalogueComment :CharacterString [0..1]
+ compressionFlag :boolean [0..1]
+ algorithmMethod :characterString [0..1]
+ sourceMedia :characterString [0..1]
+ replacedData :boolean [0..1]
+ dataReplacement :characterString [0..1]
S101_SupportFileDiscoveryMetadata
+ fileName :characterString
+ fileLocation :characterString
+ purpose :S-100_SupportFilePurpose
+ editionNumber :characterString
+ issueDate :date
+ productSpecification :S-100_ProductSpecification
+ dataType :S-100_SupportFileFormat
+ dataTypeVersion :characterString
+ comment :characterString [0..1]
+ checkSum :characterString
+ digitalSignatureReference :characterString [0..1]
+ digitalSignatureValue :characterString [0..1]
«enumeration»
S-100_SupportFormat
Text
JPEG2000
HTML
XML
XSLT
VIDEO
Other
«enumeration»
S-100_SupportFilePurpose
new
replacement
deletion
S101_DatasetDiscoveryMetadata
+ metadataFileIdentifier :characterString
+ metadataPointofContact :CI_ResponsibleParty
+ metadataDateStamp :date
+ metadataLanguage :characterString
+ fileName :characterString
+ filePath :characterString
+ description :characterString
+ dataProtection :boolean [0..1]
+ protectionScheme :characterString [0..1]
+ copyright :MD_LegalContstraints->MD_RestrictionCode <copyright> [0..*]
+ classification :MD_SecurityConstraints->MD_ClassificationCode
+ purpose :MD_Identification
+ specificUsage :characterString
+ editionNumber :characterString
+ updateNumber :characterString
+ updateApplicationDate :date [0..1]
+ issueDate :date
+ productSpecification :S-100_ProductSpecification
+ producingAgency :CI_ResponsibleParty
+ maximumDisplayScale :int [0..1]
+ minimumDisplayScale :int [0..1]
+ horizontalDatumReference :characterString = EPSG
+ horizontalDatumValue :int = 4326
+ vertialDatum :S100_VerticalAndSoundingDatum
+ soundingDatum :S100_VerticalAndSoundingDatum
+ dataType :S-100_DataFormat
+ otherDataTypeDescription :characterString [0..1]
+ dataCoverage :S101_DataCoverage [0..*]
+ checkSum :characterString
S100_CatalogueIdentifier
+ identifier :characterString
+ editionNumber :characterString
+ date :date
«enumeration»
S100_DataFormat
ISO/IEC 8211 ASCII
ISO/IEC 8211 Binary
GML
other
S-100_ProductSpecification
+ name :characterString
+ version :characterString
+ date :date
S100_CataloguePointofContact
+ orgnanization :characterString
+ phone :CI_Telephone [0..1]
+ address :CI_Address [0..1]
S101_DataCoverage
+ ID :int
+ boundingBox :EX_GeographicBoundingBox
+ boundingPolygon :EX_GeographicBoundingBox [1..*]
+ maximumDisplayScale :int [1..*]
+ minimumDisplayScale :int [1..*]

Figure 16 S-101 Exchange Set - Class Details

The following clauses define the mandatory and optional metadata needed for S-101. In some cases the metadata may be repeated in a national language. If this is the case it is noted in the Remarks column.

12.1.1 Dataset Metadata

Name	Multiplity	Value	Type	Remarks
S101_DataSetDiscoveryMetadata	-		-	-
metadataFileIdentifier	1		CharacterString	The file name must be unique. Each file name must have a MD suffix added to the S-101 file name. Dataset: GB45678.000 Metadata: MD_GB45678_000.xml Update 1: GB45678.001 Metadata: MD_GB45678_001.xml
metadataPointOfContact	1		CI_ResponsibleParty	
metadataDateStamp	1		Date	
metadataLanguage	1	English	CharacterString	All data sets conforming to S-101 PS must use English language

Name	Multiplity	Value	Type	Remarks
fileName	1		CharacterString	Dataset file name
filePath	1		CharacterString	Path to the dataset file, relative to the root directory of the exchange set. The location of the dataset file after the exchange set is unpacked into directory <EXCH_ROOT> will be: <EXCH_ROOT>/<filePath>/<fileName>
description	1		CharacterString	Short description of the area covered by dataset harbour or port name, between two named locations etc. NATIONAL LANGUAGE enabled
dataProtection	1		Boolean	e.g. Encrypted or Unencrypted
protectionScheme	0..1		CharacterString	e.g. S-63
copyright	0..*		MD_LegalConstraints ->MD_RestrictionCode <copyright> (ISO 19115)	
classification	1	{1} to {5}	Class MD_SecurityConstraints>MD_ClassificationCode (codelist)	1. unclassified 2. restricted 3. confidential 4. secret 5. top secret
purpose	1	{1} to {5}	CharacterString MD_Identification>purpose (character string)	1. New Dataset 2. New Edition 3. Update 4. Re-issue 5.Cancellation
specificUsage	1	{1} to {3}	CharacterString MD_USAGE>specificUsage (character string) MD_USAGE>userContactInfo	1. Port Entry – A dataset containing data required: For navigating the approaches to ports for navigating within ports, harbours, bays, rivers and canals, for anchorages as an aid to berthing or any combination of the above.

Name	Multiplity	Value	Type	Remarks
			(CI_ResponsibleParty)	2.Transit – A dataset containing data required for : navigating along the coastline either inshore or offshore navigating oceans, approaching coasts route planning or any combination of the above. 3.Overview – A dataset containing data required: for Ocean Crossing route planning
editionNumber	1		Integer	When a data set is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition. Edition number remains the same for re-issue.
updateNumber	1		CharacterString	Update number 0 is assigned to a new data set.
updateApplicationDate	0..1		Date	this date is only used for the base dataset files (i.e. new data sets, re-issue and newedition), not update dataset files. All updates dated on or before this date must have been applied by the producer
issueDate	1		Date	Date on which the data was made available by the data producer.
productSpecification	1	S-101 version X.X.X	S100_ ProductSpecification	This must be encoded as S-101.X.X.X – with the X representing the version number
producingAgency	1		CI_ResponsibleParty	Agency responsible for producing the data.
maximumDisplayScale	1	{1} to {15}	Integer	1: 1,000 2: 2,000 3: 3,000 4: 4,000 5: 8,000 6: 12,000 7: 22,000

Name	Multiplity	Value	Type	Remarks
				8: 45,000 9: 90,000 10: 180,000 11: 350,000 12: 700,000 13: 1,500,000 14: 3,500,000 15: 10,000,000
horizontalDatumReference	1	EPSG	CharacterString	
horizontalDatumValue	1	4326	Integer	WGS84
verticalDatum	1	{1} to {30}	S100_VerticalAndSoundingDatum	1 : Mean low water springs 2 : Mean lower low water springs 3 : Mean sea level 4 : Lowest low water 5 : Mean low water 6 : Lowest low water springs 7 : Approximate mean low water springs 8 : Indian spring low water 9 : Low water springs 10 : Approximate lowest astronomical tide 11 : Nearly lowest low water 12 : Mean lower low water 13 : Low water 14 : Approximate mean low water 15 : Approximate mean lower low water 16 : Mean high water 17 : Mean high water springs 18 : High water 19 : Approximate mean sea level 20 : High water springs 21 : Mean higher high water 22 : Equinoctial spring low water 23 : Lowest astronomical tide 24 : Local datum 25 : International Great Lakes Datum 1985 26 : Mean water level 27 : Lower low water large tide 28 : Higher high water large tide 29 : Nearly highest high water 30 : Highest astronomical tide (HAT)
soundingDatum	1	{1} to {30}	S100_VerticalAndSoundingDatum	1 : Mean low water springs 2 : Mean lower low water springs 3 : Mean sea level

Name	Multiplity	Value	Type	Remarks
				4 : Lowest low water 5 : Mean low water 6 : Lowest low water springs 7 : Approximate mean low water springs 8 : Indian spring low water 9 : Low water springs 10 : Approximate lowest astronomical tide 11 : Nearly lowest low water 12 : Mean lower low water 13 : Low water 14 : Approximate mean low water 15 : Approximate mean lower low water 16 : Mean high water 17 : Mean high water springs 18 : High water 19 : Approximate mean sea level 20 : High water springs 21 : Mean higher high water 22 : Equinoctial spring low water 23 : Lowest astronomical tide 24 : Local datum 25 : International Great Lakes Datum 1985 26 : Mean water level 27 : Lower low water large tide 28 : Higher high water large tide 29 : Nearly highest high water 30 : Highest astronomical tide (HAT)
dataType	1	ISO 8211 BINARY	S100_DataFormat	
otherDataTypeDescription	0..1		CharacterString	
dataCoverage	0..*		S101_DataCoverage	Provides information about data coverages within the dataset
checkSum	1		CharacterString NonNegativeInteger	Expressed in hex notation

12.1.1.1 S101_DataCoverage

Name	Multiplicity	Value	Type	Remarks
S101_DataCoverage	-	-	-	-

ID	1		Integer	Uniquely identifies the coverage
boundingBox	1		EX_GeographicBoundingBox	
boundingPolygon	1..*		EX_BoundingPolygon	
maximumDisplayScale	1	{1} to {15}	Integer	1: 1,000 2: 2,000 3: 3,000 4: 4,000 5: 8,000 6: 12,000 7: 22,000 8: 45,000 9: 90,000 10: 180,000 11: 350,000 12: 700,000 13: 1,500,000 14: 3,500,000 15: 10,000,000
minimumDisplayScale	1	{1} to {15}	Integer	1: 1,000 2: 2,000 3: 3,000 4: 4,000 5: 8,000 6: 12,000 7: 22,000 8: 45,000 9: 90,000 10: 180,000 11: 350,000 12: 700,000 13: 1,500,000 14: 3,500,000 15: 10,000,000

12.1.2 Support File Metadata

Name	**Multiplicity**	**Value**	**Type**	**Remarks**
S101_SupportFileDiscoveryMetadata	-		-	-
fileName	1		CharacterString	

Name	Multiplicity	Value	Type	Remarks
fileLocation	1		CharacterString	Full location from the exchange set root directory
purpose	1	{1} to {3}	class S100_SupportFilePurpose	New – A file which is new Replacement – A file which replaces an existing file Deletion – deletes an existing file
editionNumber	1		CharacterString	When a data set is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition. Edition number remains the same for a re-issue.
issueDate	1		Date	Date on which the data was made available by the data producer.
productSpecification	1		S100_ProductSpecification	Version of S-101
dataType	1	{1} to {4}	class S100_SupportFileFormat	TXT =Text files XML = Text files HTM = Text files TIFF = Picture files
dataTypeVersion	1		CharacterString	The version number of the dataType
Comment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
checkSum	1		CharacterString	
digitalSignatureReference	0..1		CharacterString	Reference to the appropriate digital signature algorithm
digitalSignatureValue	0..1		CharacterString	

12.1.3 Exchange Catalogue File Metadata

The catalogue file is defined in XML schema language. The Exchange catalogue inherits the dataset discovery metadata and support file discovery metadata.

Name	Multiplicity	Value	Type	Remarks
S101_ExchangeCatalogue	-			An exchange catalogue contains the discovery metadata about the exchange datasets and support files
identifier	1		CharacterString S100_CatalogueIdentifier	Uniquely identifies this exchange catalogue
editionNumber	1		CharacterString	The edition number of this exchange catalogue
contact	1		S100_CataloguePointofContact CI_ResponsibleParty	
date	1		Date	Creation date of the exchange catalogue
metadataLanguage	1	English	CharacterString	All data sets conforming to S-101 PS must use English language
exchangeCatalogueName	1	CATALOG.101	CharacterString	Catalogue filename
exchangeCatalogueDescription	1		CharacterString	Description of what the exchange catalogue contains NATIONAL LANGUAGE enabled
productSpecification	1			S-101 Version Number
exchangeCatalogueComment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
compressionFlag	1	{1} to {2}	CharacterString	1. Yes 2. No
algorithmMethod	0..1	{1} to {2}	CharacterString	Conditional on if compresstionFlag is set to {1} ZIP

Name	Multiplicity	Value	Type	Remarks
				RAR
sourceMedia	1			
replacedData	1			If a data file is cancelled is it replaced by another data file
dataReplacement	0..1			Dataset name

12.2 Language

The exchange language must be English. Other languages may be used as a supplementary option. National geographic names can be left in their original national language in the international attributes, or transliterated or transcribed and used in the international attributes.

Character strings must be encoded using the character set defined in ISO 10646-1, in Unicode Transformation Format-8 (UTF-8). A BOM (byte order mark) must not be used.

Annex A - Data Classification and Encoding Guide

ANNEX B - NORMATIVE

Data Product format (encoding)

B1 Introduction

S-101 uses the S-100 8211 to encapsulate data. This annex specifies the interchange format to facilitate the moving of files containing data records between computer systems. It defines a specific structure which can be used to transmit files containing data type and data structures specific to S-101.

B1.1 Data set files

The order of data in each base or update dataset file is described below:

Data set file
- Data set general information record
- Data set structure information field structure
- Data set Coordinate Reference System record structure

Information records
- Information

Vector records
- Point
- Multi point
- Curve
- Composite Curve
- Surface

Feature records
- Meta features
- Geo features
- Aggregated features
- Theme features

This order of records will enable the import software to check that the child record exists each time the parent record references it (i.e. it will already have read the child record so it will know if it exists or not).

B1.2 Records

Records and fields that do not appear in the following tree structure diagrams are prohibited. The order of records in the files must be the same as that described in these tree structure diagrams.

The combination of the file name and the “Name” of the record must provide a unique world-wide identifier of the record.

B1.3 Fields

For base dataset files, some fields may be repeated (indicated by <0..*> or <1..*>) and all of their content may be repeated (indicated by *). In order to reduce the volume of data, the encoder should repeat the sequence of subfields, in preference to creating several fields.

B1.4 Subfields

Mandatory subfields must be filled by a non-null value.

Prohibited subfields must be encoded as missing subfields values. The exact meaning of missing attribute values is defined in Annex A.

In the tables following the tree structure diagrams, prescribed values are indicated in the “values” column. The “comment” column contains general comments and an indication of whether the subfield is ASCII or binary coded.

When encoding new base data sets the record update instruction (RUIN) is always set to insert. When encoding updates it can be set to insert, modify or delete.

B1.5 Base dataset structure

NOTE: The number contained in parenthesis () is the number of subfields that are contained in the field.

```
Base dataset file
   |
   |--<1>- Data Set General Information record
   |    |
   |    |--<1>-DSID (13\\*1): Data Set Identification field
   |    |
   |    |--<1>-DSSI (13): Data Set Structure Information field
   |    |
   |    |--<0..*>-ATTR (*5): Attribute field (Metadata)
   |
   |
   |--<1>--Data Set Coordinate Reference System record
   |    |
   |    |--<1>-CSID (3): Coordinate Reference System Record Identifier field
   |    |
   |    |--<1..*>-CRSH (7): Coordinate Reference System Header field
   |       |
   |       |--<0..1>-CSAX (*2): Coordinate System Axes field
   |       |
   |       |--<0..1>-VDAT (4): Vertical Datum field
   |
   |
   |--<0..*>--Information record
   |    |
   |    |--<1>-IRID (5): Information Type Record Identifier field
   |       |
   |       |--<0..*>- ATTR (*5): Attribute field
   |       |
   |       |--<0..*>- INAS (5\\*5): Information Association field
   |
   |
   |--<0..*>-- Point record
   |    |
   |    |--<1>-PRID (4): Point Record Identifier field
   |       |
   |       |-<0..*>-INAS (5\\*5): Information Association field
   |       |
   |       | alternate coordinate representations
   |       |
   |       *-<1>-C2IT (2): 2-D Integer Coordinate Tuple field
   |       |
   |       *-<1>-C3IT (4): 3-D Integer Coordinate Tuple field
   |
   |
   |--<0..*>-- Multi Point record
   |    |
   |    |--<1>-MRID (4): Multi Point Record Identifier field
   |       |
   |       |-<0..*>-INAS (5\\*5): Information Association field
   |       |
```

```
|       | alternate coordinate representations
|       |
|       *-<0..*>-C2IL (*2): 2-D Integer Coordinate List field
|       |
|       *-<0..*>-C3IL (1\\*3): 3-D Integer Coordinate List field
|
|
|--<0..*>-- Curve record
|    |
|    |--<1>-CRID (4): Curve Record Identifier field
|       |
|       |-<0..*>-INAS (5\\*5): Information Association field
|       |
|       |-<1>-PTAS (*3): Point Association field
|       |
|       |-<1>-SEGH (1): Segment Header field
|           |
|           |-<1..*>-C2IL (*2): 2-D Integer Coordinate List field
|
|
|--<0..*>-- Composite Curve record
|    |
|    |--<1>-CCID (4): Composite Curve Record Identifier field
|       |
|       |-<0..*>-INAS (5\\*5): Information Association field
|       |
|       |-<0..*>-CUCO (*3): Curve Component field
|
|
|--<0..*>-- Surface record
|    |
|    |--<1>-SRID (4): Surface Record Identifier field
|       |
|       |-<0..*>-INAS (5\\*5): Information Association field
|       |
|       |-<1..*>-RIAS (*5): Ring Association Field
|
|
|--<0..*>-- Feature Type record
     |
     |--<1>-FRID (5): Feature Type Record Identifier field
        |
        |-<1>-FOID (3): Feature Object Identifier field
        |
        |-<0..*>-ATTR (*5): Attribute field
        |
        |-<0..*>-INAS (5\\*5): Information Association field
        |
        |-<0..*>-SPAS (*6): Spatial Association field
        |
        |-<0..*>-FASC (5\\*5): Feature Association field
        |
        |-<0..*>-THAS (*3): Theme Association field
        |
        |-<0..*>-MASK (*4): Masked Spatial Type field
```

B1.5.1 Field Content

B1.5.2 Data Set Identification field - DSID

Subfield name	Label	Value	Format	Comment

Record name	RCNM	{10}	b11	{10} - Data Set Identification
Record identification number	RCID	{1}	b14	Only one record
Encoding specification	ENSP	'S-100 Part 10a'	A()	Encoding specification that defines the encoding
Encoding specification edition	ENED	"1.1"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.0"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.0"	A()	Edition of the product specification
Application profile	PROF	"1"	A()	"1" – EN Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset abstract	DSAB	omitted	A()	The abstract of the dataset
Dataset edition	DSED		A()	See clause ??
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

B1.5.3 Data Set Structure Information field - DSSI

Subfield name	Label	Value	Format	Comment
Dataset Coordinate Origin X	DCOX	{0.0}	b48	Shift used to adjust x-coordinate before encoding
Dataset Coordinate Origin Y	DCOY	{0.0}	b48	Shift used to adjust y-coordinate before encoding
Dataset Coordinate Origin Z	DCOZ	{0.0}	b48	Shift used to adjust z-coordinate before encoding
Coordinate multiplication factor for x-coordinate	CMFX	$\{10^7\}$	b14	Floating point to integer multiplication factor for the x-coordinate or longitude
Coordinate multiplication factor for y-coordinate	CMFY	$\{10^7\}$	b14	Floating point to integer multiplication factor for the y-coordinate or latitude
Coordinate multiplication factor for z-coordinate	CMFZ	{100}	b14	Floating point to integer multiplication factor for the z-coordinate or depths or height
Number of Information Type records	NOIR		b14	Number of information records in the data set
Number of Point records	NOPN		b14	Number of point records in the data set
Number of Multi Point records	NOMN		b14	Number of multi point records in the data set
Number of Curve records	NOCN		b14	Number of curve records in the data set
Number of Composite Curve records	NOXN		b14	Number of composite curve records in the data set
Number of Surface records	NOSN		b14	Number of surface records in the data set
Number of Feature Type records	NOFR		b14	Number of feature records in the data set

B1.5.4 Attribute field - ATTR

Subfield name	Label	Value	Format	Comment
Attribute label/code	*ATLB		b12	A valid attribute code
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN	{1}	b11	{1} - Insert
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B1.5.5 Information Association field - INAS

Subfield name	Label	Value	Format	Subfield content and specification
Referenced Record name	*RRNM	150	b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Information Association code	IASS		b12	A valid code for the information association
Role code	ROLE		b12	A valid code for the role
Information Association Update Instruction	IUIN		b11	{1} - Insert {2} – Delete {3} - Modify
Attribute label/code	*ATLB		b12	A valid attribute code
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this INAS field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B1.5.6 Coordinate Reference System Record Identifier field - CSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{15}	b11	{15} - Coordinate Reference System Identifier
Record identification number	RCID	{1}	b14	Only one record
Number of CRS Components	NCRC		b11	{1} - Single CRS >{1} - Compound CRS

B1.5.7 Coordinate Reference System Header field - CRSH

Subfield name	Label	Value	Format	Comment
CRS index	CRIX		b11	1 – for the horizontal CRS >1 – for the vertical CRS's
CRS Type	CRST	{1} or {5}	b11	{1} – 2D Geographic {5} - Vertical
Coordinate System Type	CSTY	{1} or {3}	b11	{1} - Ellipsoidal CS {3} - Vertical CS
CRS Name	CRNM	"WGS84" for horizontal CRS "Depth - *" for vertical CRS where * is the name of the	A()	

		vertical datum		
CRS Identifier	CRSI	"4326" – for horizontal CRS "omitted for vertical CRS	A()	
CRS Source	CRSS	{3} for horizontal CRS {255} for vertical CRS	b11	{3} - EPSG {255} - Not Applicable
CRS Source Information	SCRI	omitted	A()	

B1.5.8 Coordinate System Axes field - CSAX

This field is only used for vertical CRS.

Subfield name	Label	Value	Format	Comment
Axis Type	*AXTY	{12}	b11	{12} – Gravity related depth (orientation down)
Axis Unit of Measure	AXUM	{4}	b11	{4} - Metre

B1.5.9 Vertical Datum field – VDAT

This field is only used for vertical CRS.

Subfield name	Label	Value	Format	Comment
Datum Name	DTNM		A()	Name of the enumeration value of the attribute VERDAT
Datum Identifier	DTID		A()	Enumeration value of the attribute VERDAT
Datum Source	DTSR	{2}	b11	{2} - Feature Catalogue
Datum Source Information	SCRI	omitted	A()	

B1.5.10 Information Type Identifier field - IRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{150}	b11	{150} - Information Type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Object code	OBJC		b12	A valid information type code from the FC
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B1.5.11 Point Record Identifier field - PRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{110}	b11	{110} - Point
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} – Insert

B1.5.12 2-D Integer Coordinate Tuple field structure – C2IT

Subfield name	Label	Value	Format	Comment
Coordinate in Y axis	*YCOO		b24	Y-coordinate or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or longitude

B1.5.13 3-D Integer Coordinate Tuple field structure– C3IT

Subfield name	Label	Value	Format	Comment
Vertical CRS Id	VCID		b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	*YCOO		b24	Y- coordinate or latitude
Coordinate in X axis	XCOO		b24	X- coordinate or longitude
Coordinate in Z axis	ZCOO		b24	Z - coordinate (depth)

B1.5.14 Multi Point Record Identifier field - MRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{115}	b11	{115} - Multi Point
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B1.5.15 2-D Integer Coordinate List field structure – C2IL

Subfield name	Label	Value	Format	Subfield content and specification
Coordinate in Y axis	*YCOO		b24	Y-coordinate or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or longitude

B1.5.16 3-D Integer Coordinate List field structure – C3IL

Subfield name	Label	Format	Subfield content and specification
Vertical CRS Id	VCID	b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	*YCOO	b24	Y- coordinate or latitude
Coordinate in X axis	XCOO	b24	X- coordinate or longitude
Coordinate in Z axis	ZCOO	b24	Z - coordinate (depth or height)

B1.5.17 Curve Record Identifier field - CRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{120}	b11	{120} - Curve
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B1.5.18 Point Association field - PTAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Topology indicator	TOPI		b11	{1} - Beginning point {2} - End point {3} - Beginning & End point

B1.5.19 Segment Header field - SEGH

Subfield name	Label	Value	Format	Comment
Interpolation	INTP	{4}	b11	{4} - Loxodromic

B1.5.20 Composite Curve Record Identifier field - CCID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{125}	b11	{125} - Composite Curve
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B1.5.21 Curve Component field - CUCO

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse

B1.5.22 Surface Record Identifier field - SRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{130}	b11	{130} - Surface
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} – Insert

B1.5.23 Ring Association field - RIAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse
Usage indicator	USAG		b11	{1} - Exterior {2} - Interior
Ring Association update instruction	RAUI	{1}	b11	{1} – Insert

B1.5.24 Feature Type Record Identifier field - FRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{100}	b11	{100} - Feature type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Object code	OBJC		b12	A valid feature type code from the FC
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B1.5.25 Feature Object Identifier field - FOID

Subfield name	Label	Value	Format	Comment
Producing agency	AGEN		b12	Agency code
Feature identification number	FIDN		b14	Range: 1 to 2^{32}-2
Feature identification subdivision	FIDS		b12	Range: 1 to 2^{16}-2

B1.5.26 Spatial Association field - SPAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} Forward {2} Reverse {255} NULL (Not Applicable)
Scale Minimum	SMIN		b14	Denominator of the largest scale for which the feature type can be depicted by the referenced spatial object. If the value is 0 it does not apply.
Scale Maximum	SMAX		b14	Denominator of the smallest scale for which the feature type can be depicted by the referenced spatial object. If the value is 2^{32}-1 it does not apply.
Spatial Association Update Instruction	SAUI	{1}	b11	{1} - Insert

B1.5.27 Feature Association field – FASC

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Feature Association Code	ASCD		b12	A valid code for the feature association
Role Code	RLCD		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1}	b11	{1} - Insert
Attribute label/code	*ATLB		b12	A valid attribute code
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this FASC field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B1.5.28 Theme Association field - THAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Theme Association Update Instruction	TAUI	{1}	b11	{1} - Insert

B1.5.29 Masked Spatial Type field - MASK

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Mask Indicator	MIND	{1} or {2}	b11	{1} – Truncated by the dataset limit {2} – Supress portrayal
Mask Update Instruction	MUIN	{1}	b11	{1} - Insert

B1.6 Update dataset structure

```
Update dataset file
   |
   |--<1>- Data Set General Information record
   |    |
   |    |--<1>-DSID (13\\*1): Data Set Identification field
   |    |
   |    |--<1>-DSSI (13): Data Set Structure Information field
   |    |
   |    |--<0..*>-ATTR (*5): Attribute field (Metadata)
   |
   |
   |--<0..*>--Information record
   |    |
   |    |--<1>-IRID (5): Information Type Record Identifier field
   |       |
   |       |--<0..*>- ATTR (*5): Attribute field
   |       |
   |       |--<0..*>- INAS (5\\*5): Information Association field
   |
   |
   |--<0..*>-- Point record
   |    |
   |    |--<1>-PRID (4): Point Record Identifier field
   |       |
   |       |-<0..*>-INAS (5\\*5): Information Association field
   |       |
   |       | alternate coordinate representations
   |       |
   |       *-<1>-C2IT (2): 2-D Integer Coordinate Tuple field
   |       |
   |       *-<1>-C3IT (4): 3-D Integer Coordinate Tuple field
   |
   |
   |--<0..*>-- Multi Point record
   |    |
   |    |--<1>-MRID (4): Multi Point Record Identifier field
   |       |
   |       |-<0..*>-INAS (5\\*5): Information Association field
   |       |
   |       |-<0..1>-COCC (3): Coordinate Control field
   |       |
   |       | alternate coordinate representations
   |       |
   |       *-<0..*>-C2IL (*2): 2-D Integer Coordinate List field
   |       |
   |       *-<0..*>-C3IL (1\\*3): 3-D Integer Coordinate List field
   |
   |
   |--<0..*>-- Curve record
   |    |
   |    |--<1>-CRID (4): Curve Record Identifier field
   |       |
   |       |-<0..*>-INAS (5\\*5): Information Association field
```

```
|       |
|       |-<1>-PTAS (*3): Point Association field
|       |
|       |-<0..1>-SECC (3): Segment Control field
|       |
|       |-<1>-SEGH (1): Segment Header field
|           |
|           |-<0..1>-COCC (3): Coordinate Control Field
|           |
|           |-<1..*>-C2IL (*2): 2-D Integer Coordinate List field
|
|
|--<0..*>-- Composite Curve record
|    |
|    |--<1>-CCID (4): Composite Curve Record Identifier field
|       |
|       |-<0..*>-INAS (5\\*5): Information Association field
|       |
|       |-<0..1>-CCOC (3): Curve Component Control field
|       |
|       |-<0..*>-CUCO (*3): Curve Component field
|
|
|--<0..*>-- Surface record
|    |
|    |--<1>-SRID (4): Surface Record Identifier field
|       |
|       |-<0..*>-INAS (5\\*5): Information Association field
|       |
|       |-<1..*>-RIAS (*5): Ring Association Field
|
|
|--<0..*>-- Feature Type record
     |
     |--<1>-FRID (5): Feature Type Record Identifier field
        |
        |-<1>-FOID (3): Feature Object Identifier field
        |
        |-<0..*>-ATTR (*5): Attribute field
        |
        |-<0..*>-INAS (5\\*5): Information Association field
        |
        |-<0..*>-SPAS (*6): Spatial Association field
        |
        |-<0..*>-FASC (*5): Feature Association field
        |
        |-<0..*>-THAS (*3): Theme Association field
        |
        |-<0..*>-MASK (*4): Masked Spatial Type field
```

B1.6.1 Field Content

B1.6.2 Data Set Identification field - DSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{10}	b11	{10} - Data Set Identification
Record identification number	RCID	{1}	b14	Only one record
Encoding specification	ENSP	'S-100 Part 10a'	A()	Encoding specification that defines the encoding
Encoding specification edition	ENED	"1.1"	A()	Edition of the encoding specification

Product identifier	PRSP	"INT.IHO.S-101.1.0"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.0"	A()	Edition of the product specification
Application profile	PROF	"2"	A()	"2" – ER Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset abstract	DSAB	omitted	A()	The abstract of the dataset
Dataset edition	DSED		A()	See clause ??
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

B1.6.3 Data Set Structure Information field - DSSI

Subfield name	Label	Value	Format	Comment
Dataset Coordinate Origin X	DCOX	{0.0}	b48	Shift used to adjust x-coordinate before encoding
Dataset Coordinate Origin Y	DCOY	{0.0}	b48	Shift used to adjust y-coordinate before encoding
Dataset Coordinate Origin Z	DCOZ	{0.0}	b48	Shift used to adjust z-coordinate before encoding
Coordinate multiplication factor for x-coordinate	CMFX	$\{10^7\}$	b14	Floating point to integer multiplication factor for the x-coordinate or longitude
Coordinate multiplication factor for y-coordinate	CMFY	$\{10^7\}$	b14	Floating point to integer multiplication factor for the y-coordinate or latitude
Coordinate multiplication factor for z-coordinate	CMFZ	{100}	b14	Floating point to integer multiplication factor for the z-coordinate or depths or height
Number of Information Type records	NOIR		b14	Number of information records in the data set
Number of Point records	NOPN		b14	Number of point records in the data set
Number of Multi Point records	NOMN		b14	Number of multi point records in the data set
Number of Curve records	NOCN		b14	Number of curve records in the data set
Number of Composite Curve records	NOXN		b14	Number of composite curve records in the data set
Number of Surface records	NOSN		b14	Number of surface records in the data set
Number of Feature Type records	NOFR		b14	Number of feature records in the data set

B1.6.4 Attribute field - ATTR

Subfield name	Label	Value	Format	Comment
Attribute label/code	*ATLB		b12	A valid attribute code
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).

Parent index	PAIX		b12	Index (position) of the parent complex attribute within this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN	{1}, {2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B1.6.5 Information Association field

Field Tag: **INAS**	Field Name: Information Association

Subfield name	Label	Value	Format	Subfield content and specification
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Information Association	IASS		b12	A valid code for the information association
Role	ROLE		b12	A valid code for the role
Information Association Update Instruction	IUIN		b11	{1} - Insert {2} – Delete {3} - Modify
Attribute label/code	*ATLB		b12	A valid attribute code
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B1.6.6 Information Type Identifier field - IRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{150}	b11	{150} - Information Type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Object code	OBJC		b12	A valid information type code from the FC
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1},{2} or {3}	b11	{1} – Insert {2} - Delete {3} - Modify

B1.6.7 Point Record Identifier field - PRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{110}	b11	{110} - Point
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1},{2} or {3}	b11	{1} – Insert {2} - Delete

				{3} - Modify

B1.6.8 2-D Integer Coordinate Tuple field structure – C2IT

Subfield name	Label	Value	Format	Comment
Coordinate in Y axis	*YCOO		b24	Y-coordinate or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or longitude

B1.6.9 3-D Integer Coordinate Tuple field structure – C3DI

Subfield name	Label	Value	Format	Comment
Vertical CRS Id	VCID		b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	*YCOO		b24	Y- coordinate or latitude
Coordinate in X axis	XCOO		b24	X- coordinate or longitude
Coordinate in Z axis	ZCOO		b24	Z - coordinate (depth)

B1.6.10 Multi Point Record Identifier field - MRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{115}	b11	{115} - Multi Point
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1},{2} or {3}	b11	{1} – Insert {2} - Delete {3} - Modify

B1.6.11 2-D Integer Coordinate List field structure – C2IL

Subfield name	Label	Value	Format	Subfield content and specification
Coordinate in Y axis	*YCOO		b24	Y-coordinate or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or longitude

B1.6.12 3-D Integer Coordinate List field structure – C3IL

Subfield name	Label	Format	Subfield content and specification
Vertical CRS Id	VCID	b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	*YCOO	b24	Y- coordinate or latitude
Coordinate in X axis	XCOO	b24	X- coordinate or longitude
Coordinate in Z axis	ZCOO	b24	Z - coordinate (depth or height)

B1.6.13 Coordinate Control field - COCC

Subfield name	Label	Value	Format	Comment
Coordinate Update Instruction	COUI	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Coordinate Index	COIX		b12	Index (position) of the addressed coordinate tuple within the coordinate field(s) of the target record
Number of Coordinates	NCOR		b12	Number of coordinate tuples in the coordinate field(s) of the update record

B1.6.14 Curve Record Identifier field - CRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{120}	b11	{120} - Curve
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B1.6.15 Point Association field - PTAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Topology indicator	TOPI		b11	{1} - Beginning point {2} - End point {3} - Beginning & End point

B1.6.16 Segment Control field - SECC

Subfield name	Label	Value	Format	Comment
Segment update instruction	SEUI	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Segment index	SEIX		b12	Index (position) of the addressed segment in the target record
Number of segments	NSEG		b12	Number of segments in the update record

B1.6.17 Segment Header field - SEGH

Subfield name	Label	Value	Format	Comment
Interpolation	INTP	{4}	b11	{4} - Loxodromic

B1.6.18 Composite Curve Record Identifier field - CCID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{125}	b11	{125} - Composite Curve
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B1.6.19 Curve Component Control field - CCOC

Subfield name	Label	Value	Format	Comment
Curve Component update instruction	CCUI		b11	{1} - Insert {2} - Delete {3} - Modify
Curve Component index	CCIX		b12	Index (position) of the addressed Curve record pointer within the CUCO field(s) of the target record

Number of Curve Components	NCCO		b12	Number of Curve record pointer in the CUCO field(s) of the update record

B1.6.20 Curve Component field - CUCO

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse

Surface Record Identifier field - SRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{130}	b11	{130} - Surface
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

Ring Association field - RIAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse
Usage indicator	USAG		b11	{1} - Exterior {2} - Interior
Ring Association update instruction	RAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

B1.6.21 Feature Type Record Identifier field - FRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{100}	b11	{100} - Feature type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Object code	OBJC		b12	A valid feature type code from the FC
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B1.6.22 Feature Object Identifier field - FOID

Subfield name	Label	Value	Format	Comment
Producing agency	AGEN		b12	Agency code
Feature identification number	FIDN		b14	Range: 1 to 2^{32}-2
Feature identification subdivision	FIDS		b12	Range: 1 to 2^{16}-2

B1.6.23 Spatial Association field - SPAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM	{1} to {5}	b11	Record name of the referenced record {1} - 110 {2} - 115 {3} - 120 {4} - 125 {5} - 130
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} Forward {2} Reverse {255} NULL (Not Applicable)
Scale Minimum	SMIN		b14	Denominator of the largest scale for which the feature type can be depicted by the referenced spatial object. If the value is 0 it does not apply.
Scale Maximum	SMAX		b14	Denominator of the smallest scale for which the feature type can be depicted by the referenced spatial object. If the value is 2^{32}-1 it does not apply.
Spatial Association Update Instruction	SAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

B1.6.24 Feature Association field – FASC

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Association Code	FASS		b12	A valid code for the association
Role Code	ROLE		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1} ,{2} or {3}	b11	{1} - Insert {2} – Delete {3} - Modify
Attribute label/code	*ATLB		b12	A valid attribute code
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B1.6.25 Theme Association field - THAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Theme Association Update Instruction	TAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

B1.6.26 Masked Spatial Type field - MASK

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Mask Indicator	MIND	{1} or {2}	b11	{1} – Truncated by the dataset limit {2} – Supress portrayal
Mask Update Instruction	MUIN	{1} or {2}	b11	{1} - Insert {2} - Delete

B1.7 Dataset cancellation structure

```
Dataset cancelation file
   |
   |--<1>- Data Set General Information record
       |
       |--<1>-DSID (13\\*1): Data Set Identification field
```

B1.7.1 Field Content

B1.7.2 Data Set Identification field - DSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{10}	b11	{10} - Data Set Identification
Record identification number	RCID	{1}	b14	Only one record
Encoding specification	ENSP	'S-100 Part 10a'	A()	Encoding specification that defines the encoding
Encoding specification edition	ENED	"1.1"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.0"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.0"	A()	Edition of the product specification
Application profile	PROF	"2"	A()	"2" – ER Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset abstract	DSAB	omitted	A()	The abstract of the dataset
Dataset edition	DSED	"0"	A()	0 - indicates the cancelation
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

Annex C – Normative

Implementation Guidance

<Things that need to be added to the Implementation Guidance>

1. Examples of allowable dataCoverage
2. Feature and Portrayal Catalogue Management
3. S-52 subworking group to review the latest version of S-52and incorporate relevant sections into S-101

C1 Overview

C1.1 Introduction

The purpose of this Normative Annex is to provide additional implementation guidance for S-101. While the product specification provides the main rules, this annex will provide additional information and use cases for implementation.

This annex is set up to be a cross-reference to S-101, therefore its clause numbering will refer back to the originating guidance in S-101.

EXAMPLE: If there is additional guidance in for dataset loading and unloading (4.6.1) it will have a clause in this annex that corresponds with the main product specification (C4.6.1).

C4 Data Content and structure

C4.3 Feature Catalogue

The S-101 feature catalogue is in XML and describes the various feature types, information types, attributes, attribute values, associations, roles and their bindings that are used for ENC datasets. The feature catalogue will be tied to a version of the S-101 product specification and may be obtained from the IHO website or may be delivered with S-101 datasets as part of the exchange catalogue.

C8 Maintenance

C8.5 Feature and Portrayal Catalogue Management

OPTION 2: For each new edition of the product specification, a cumulative feature and portrayal catalog is released. Therefore the ECDIS will only have to manage a single feature catalog and portrayal catalog.

In order for Option 2 to be feasible there will have to be some rules outlined. In order to develop the proper rules a few scenarios are outlined.

At this point we will only focus on Feature Catalogues, although the principles should be the same for portrayal catalogues.

Commentaire [r5]: I think the purpose of this annexe needs to be more clearly defined. Currently it seems to cover a lot which should be in an ECDIS performance standard and that which will be within the portrayal catalogue. Suggest this section should be kept to a minimum.

JLP: Once we have a portrayal catalogue we can take some more things out.

Commentaire [JLP6]: US(NOAA): Currently there is not a lot of implementation guidance in this annex – with the exception of portrayal. I think things are getting ignored.

Propose to move the implementation guidance – with the exception of the portrayal back to the main product specification. Once S-101 is in test beds then TSMAD can make a better determination of what guidance is needed.

Commentaire [JLP7]: Needs to add in how the portrayal and Feature Catalogues will be used by the system.

Commentaire [JLP8]: TSMAD26: Decided to move forward with this option. Wording needs to be improved.

- A key principle is each version a feature catalogue is tied to the version of the product specification.
- A single feature catalogue must be backwards compatible with existing data. Older FC data must load when a newer FC is in use.
- Data can only be issued conforming to the new catalogue when that catalogue has been published.
- Data must not load if it conforms to a FC not held by the system.

There are at least three scenarios that will trigger a change to a feature catalogue where specific rules must be laid out.

Scenario	Data exists	OK?	PS Ver	FC Ver
Add new item	-	Y	1.1.0	1.1
Change item	N	Y	1.1.0	1.1
Change item	Y	Y (add)	1.1.0	1.1
Remove item	N	Y	1.1.0	1.1
Remove item	Y	N (sunset)	-	-

Scenario 1 – Additions to the Feature Catalogue

Over time, there will be additions to the feature catalogue. There can be additions of **attributes**, **attribute values** or **features**. Once the new additions have been approved the Product Specification and accompanying Feature Catalogue must uptick accordingly. Existing data must not already contain these values and in order to reflect their inclusion data has to be edited. Historically most issues can be addressed with an addition.

Additions Example – The addition of a new Topmark Feature

1. A new Topmark is proposed to TSMAD

2. TSMAD agree the addition and it's submitted to the registry and added to a revised Feature Catalogue.
3. The feature catalogue is tested by producers and ECDIS manufacturers.
4. The catalogue is published and made available. (Along with an uptick in the Product Specification)
5. Producers begin to encode the new values.
6. In systems which do not have the latest catalogue datasets conforming to it will not load data conforming to the new catalogue.
7. Data conforming to older catalogues still loads.

Scenario 2 – Changes to the Feature Catalogue

A change can be a complex attribute replacing a simple attribute or the removal of a feature, attribute or feature attribute. The following rules must apply;

1) Changes where data is currently encoded in this way must be additions for example a complex attribute in addition to an existing simple attribute. Existing data can then be deprecated (sunset).

2) Removals must only be made when no ENC data contains these values. TSMAD will manage deprecation of items through the DCEG.

Change Example - A new complex is created for light sectors

1. A proposal is made to create a complex for light sectors, thus replacing SECTR1 and SECTR2
2. TSMAD agree the addition and it's submitted to the registry and added to a revised Feature Catalogue.
3. The feature catalogue is tested by producers and ECDIS manufacturers.
4. The catalogue is published and made available. (Along with an uptick in the Product Specification)
5. Producers begin to encode the new values.
6. In systems which do not have the latest catalogue datasets conforming to it will not load data conforming to the new catalogue.
7. Data conforming to older catalogues still loads

Removal Example – Values are removed from the feature catalogue

1. As a result of the creation of a complex attribute the attribute values SECTR1 and SECTR2 are removed from the feature catalogue.
2. TSMAD agree the removal and it's submitted to the registry and removed from a revised Feature Catalogue.
3. The feature catalogue is tested by producers and ECDIS manufacturers.

4. The catalogue is published and made available. (Along with an uptick in the Product Specification)
5. Producers begin to encode the new values.
6. In systems which do not have the latest catalogue datasets conforming to it will not load data conforming to the new catalogue.
7. Data conforming to older catalogues still loads

C9 Portrayal

THIS SECTION WILL CONTAIN ALL THE BUSINESS RULES FOR PORTRAYAL. MUCH OF THIS WILL COME FROM S-52.

C9.1 Introduction

This section contains additional guidance for the implementation of portrayal within an S-101 enabled ECDIS. While much of the existing S-52 presentation library is now housed in the portrayal catalogue, this clause contains subsets of S-52 – *Specifications for Chart Content and Display Aspects of ECDIS*, which are still required for ECDIS to conform to the IMO Performance Specification and IEC 61174.

C9.1.1 ECDIS "Display Generator" Concept <<Annex A.2 >>

The elements of S-101 portrayal are handled by an ECDIS Display Generator that is designed by each manufacturer, following the specifications outlined in S-101. The S-101 Portrayal Catalogue provides the link between the feature characteristics according to S-101 and the actual presentation on the ECDIS screen.

NOTE: The Display Generator is not provided in S-101. This must be developed by the manufacturer.

Figure 1 shows how the various portrayal elements can be linked together in order to display an S-101 feature from the SENC. The individual elements (symbols, symbol display rules, etc.) are provided in the portrayal register and are collected together in the portrayal catalogue, which is a machine readable file to allow for an enhanced change mechanism for new versions of the feature and portrayal catalogues.

NOTE: "Date-dependant features," which discusses the display of features depending on date in the following complex attributes, such as **fixedDateRange** and **periodicDateRange**. The requirement to display date-dependent information outside the date at which it is active (for route planning etc.) means that the date-filter in the first diamond of figure 1 will be deliberately by-passed on request by the mariner. When this option is in use, the mariner must be reminded that the information on the display may not be correct for the actual, current, date and time. The **maximumDisplayScale** and **minimumDisplayScale** set for each **DataCoverage** feature and the value of the SCAMIN attribute also affects the display of certain features.

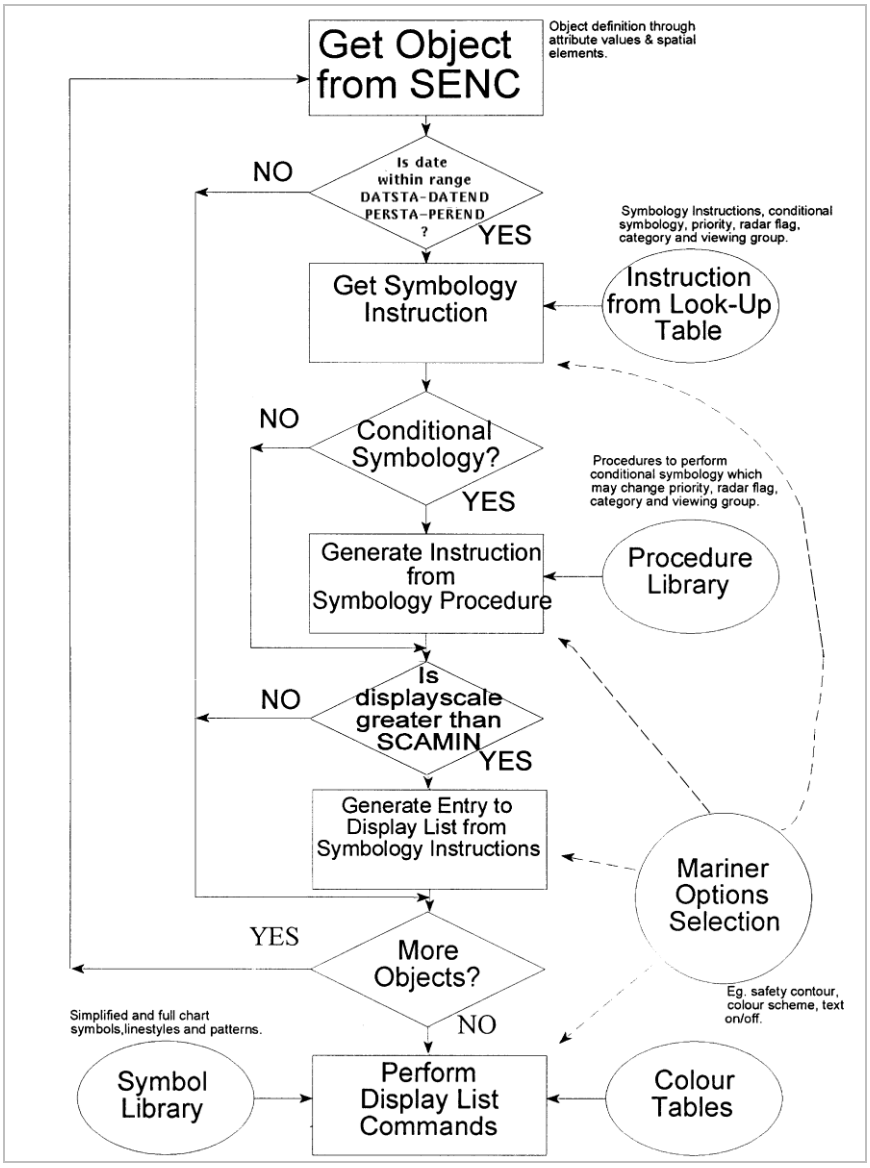


Fig. 1 - Display generator concept

After all features have been examined by the programmed loop, the display list is filled with graphic commands. The commands are then performed by the ECDIS, which in turn loads symbols from the symbol library and gets the colour values from the colour tables. This method to generate an ECDIS display gives the mariner control over the contents and the appearance of the presentation:

If the mariner selects another safety contour, the display list is renewed in the programmed loop and the depth areas distinguishing shades are changed by a symbology procedure which is called to generate symbology instructions for the feature class DEPARE (depth area);

or symbology instructions which refer to the plain-boundaries or symbolized-boundaries areas, and lines by switching to another portrayal rule based on the mariner's preference

or the generation of the display list is influenced by a filter suppressing text commands;

or the colour values for the day time are replaced with the values for the night time by selecting another colour table.

NOTE: The ECDIS should not initiate any change of state automatically or by linkage, e.g., it should not automatically select "lights" because the mariner selects the night colour table. All changes to the composition of the display should be initiated by the mariner.

C9.2 Tidal Adjustment <<1.2(f)>>

Commentaire [J9]: IEC 61174 ref

Depth information should only be displayed as it has been provided in the ENC and not adjusted by tidal height. If the ECDIS has integrated the use of a S-10X tidal product specification, it may display the adjusted tide as an italicized offset to the sounding in the ENC.

C9.3 Physical Display << MAIN 5.1 >>

Commentaire [N10]: IEC 61174 ref

Portrayal requirements for the main graphic display are:

Size: minimum effective size of the area for chart display: 270 x 270 mm.

Resolution: minimum lines per mm (L) given by L=864/s, where s is the smaller dimension of the chart display area. (e.g. for the minimum chart area, s=270 mm and the resolution L=3.20 lines per mm, giving a "picture unit" size of 0.312 mm)

Number of Colours: 64

Information should be displayed in the ECDIS on one or more physical screens, which may be divided into more than one chart display. Information may be displayed automatically, on demand or as a result of mariners' selection.

Redraw during route monitoring to follow the ship's progress, including scale changes due to change in the scale of the chart information, should take less than 5 seconds. Demands by the mariner that cannot be predicted by the ECDIS, such as draw at a different scale or in a different area may take more than 5 seconds. In the latter case:

Commentaire [JLP11]: NO: Says that the display must be redrawn within 5 seconds. Assuming this requirement comes from IEC 61174, but is this really quick enough screen redraw to facilitate for ships moving at high speed? They travel quite a distance in 5 seconds.

No change proposed, just wondering...

- the mariner should be informed;
- the display should continue route monitoring until the new information is ready to draw within 5 seconds.

The specifications above permit a chart display whose minimum resolution (lines/mm) may vary depending on the size of the display. To maintain a clearly readable chart display under this flexibility requires the following constraints to ensure that enough "picture units" (pixels) are always used to draw small features and symbols clearly:

Chart features: Chart features should never be drawn with fewer "picture units" (i.e., lines, pixels, dot-pitch intervals) than when drawn on a 270 x 270 mm chart area at SENC scale.

Symbols: For clear representation, symbols require a minimum number of picture units, depending on their complexity. A simple chart symbol should extend about 12 pixels (that is at least 3.5mm for an IHO standard screen.) See section 9.4 for details on the size of symbols.

C9.4 Units << MAIN 2.3.1f >>

There must be no ambiguity about the units in use at a particular time. The units listed below must be indicated in the display legend:

1) Position: latitude and longitude in degrees, minutes and decimal minutes.

2) Depth: metres and decimetres.

3) Height: metres.

4) Distance: nautical miles and decimal miles, or metres.

5) Speed: knots and decimal knots.

C9.5 Size of lines symbols and text; fonts <<3.1.5>>

Commentaire [N12]: IEC 61174 ref

Lines and symbols and text should be large enough that they can be easily interpreted at the operational viewing distance. This will be about 70 cm for route planning, but experience to date indicates that the viewing distance for important features during route monitoring may be several metres.

The minimum sizes for all symbols should be as shown in the Portrayal Catalogue.

In addition, the symbols should always be drawn with at least the same number of pixels as are required to draw the symbol at the size defined in the portrayal catalogue for the minimum resolution and minimum chart display area (270x270 mm).

When the display scale is enlarged by zooming in, it should be possible to hold symbol size constant. The same applies to text. Symbol and text size should never be decreased when zooming out.

The text on the ECDIS should be readable from 1 metre.* Sans serif, non-italic fonts should be used. The computer ø should not be used.

C9.6 Colours << Adapted from MAIN 4.2 & MAIN 4.1 & MAIN 4.2.6 & ANNEX A 3.1 >>

The design of both colours and symbols ensures that important chart and navigation features remain clearly visible under the extremes of bright sun and dark night viewing. Note that these colour specifications apply to both the operational chart display (for route planning and route monitoring), and also to any text on the same screen as the chart display.

C9.6.1 Colour Tables

Three colour tables have been carefully designed by perception specialists to give the maximum clarity and contrast between features on the display under all light conditions on the bridge. The ECDIS must enable mariners to switch among all three colour tables specified (day, night and dusk).

DAY – The Day Colour Table uses a white background as a result of a comparative test outdoors in bright sunlight which showed that a display background of maximum luminance gives the best contrast achievable under near-washout conditions. This conclusion has been confirmed by subsequent sea experience.

DUSK – The Dusk Colour Table is a black background table, which may also be used by day as a mariner's option.

NIGHT – At night the light emitted by the display must be strictly limited to avoid impairing night vision. In case the luminance needs to be further reduced, the Night Colour Table may be augmented by a

luminance-reducing neutral density filter which should have 8 times attenuation, designated (logarithmically) "0.9 ND". (This is a manufacturer's option).

The colours are specified in CIE (Commission Internationale de l'Eclairage) xy chromaticity coordinates and luminance L. CIE colour coordinates are used because any other colour specification, such as RGB, is specific to a particular monitor and so cannot be specified either in relative or in absolute terms.

The colour tables and other detailed information about the assignment of colours is provided in the Portrayal Register.

C9.6.2 Colour Tokens

A look-up table assigns all feature/attribute combinations of features from the SENC to one of 64 "colour tokens". Each colour usage is represented by a token that is a five-letter code. Each colour token corresponds to a colour definition given in CIE coordinates in one of a set of colour tables for different bridge lighting conditions (day, dusk and night). A few tokens apply to only one feature, but most include a group of similar features. For example, traffic lanes, traffic direction arrows, prohibited areas and other such features share the "trfcd" for "traffic control dominant (conspicuous)" colour token. Each token is assigned colour coordinates for each table in the Hydro Portrayal Register.

C9.6.3 Transparency

Transparent area colour fill is used so that the background colours, lines and symbols show through an area shade (e.g. depth shades and contours should show through a traffic separation zone) and to reduce the prominence of a large symbol (e.g. too prominent a centred anchorage area symbol would cause clutter on the display). Any method used by the ECDIS manufacturer to obtain various degrees of transparency is acceptable.

C9.7 Abbreviations << ANNEX A, 7.1.3.2 & ANNEX A 13.4 >>

The abbreviations used on the ECDIS display are listed below. The meaning of each of these abbreviations must be readily accessible to the mariner. Note that a few abbreviations, such as “DW” for deep water route and “IT” for inshore traffic zone, are used as symbols; The meaning of these abbreviations must be readily accessible to the mariner as well.

C9.7.1 “TE” text command abbreviations

Commentaire [CAH13]: This section will have to be modified, based on the final portrayal model

The abbreviations in the table below are used with the “TE” command word.

Prefixes	Suffixes	‘C’ Format Command
bn = beacon (INT1) by = buoy clr = overhead clearance clr cl = clearance closed clr op = clearance open sf clr = safe clearance No = number (INT1) Plt = pilot Prod = offshore production (INT1) LtV = light vessel Varn = magnetic variation	kn = knots (INT1) deg = degrees	% = instruction follows %s = text string %d = integer number %n.mlf = floating point number with n characters (including the decimal), m of which come after the decimal point

ch = communication channel NMT = not more than “CLEARING BEARING” NLT = not less than “CLEARING BEARING”		

C9.7.2 Light Description Abbreviations

The following abbreviations are used to display light characteristics in ECDIS.

Al	alternating	Dir	directional
~~Al~~	~~group alternating~~	Aero	aeronautical
AlF Fl	alternating fixed and flashing		
AlFl	alternating flash	W	White
AlLFl	alternating long-flash	R	Red
AlOc Fl	alternating occulting/flashing	G	Green
AlOc	alternating occulting	Y	Yellow
F	fixed		
FFl	fixed and flashing	occas	occasional
Fl	flashing	temp	temporary
Fl+LFl	flash/long-flash	priv	private
FLFl	fixed/long-flash	exting	extinguished
IQ	interrupted quick-flashing		
Iso	isophased	m	metres
IUQ	interrupted ultra quick-flashing	M	nautical miles
IVQ	interrupted very quick-flashing		
LFl	long-flashing		
Mo	morse		
Oc	occulting		
Q	quick-flashing		
Q+LFl	quick-flash plus long-flash		
UQ	ultra quick-flashing		
UQ+LFl	ultra quick-flash plus long-flash		
VQ	very quick-flashing		
VQ+LFl	very quick-flash plus long-flash		

C9.7.3 Nature of seabed abbreviations ('TX')

The abbreviations in the table below may be used for values of NATSUR - nature of seabed.

Commentaire [N14]: This may change depending on what the mariner would like to see. Either way it should either be one or the other.

NATSUR 1	mud	M	NATSUR 8	cobbles	Cb
NATSUR 2	clay	Cy	NATSUR 9	rock	R
NATSUR 3	silt	Si	NATSUR 11	lava	R
NATSUR 4	sand	S	NATSUR 14	coral	Co
NATSUR 5	stones	St	NATSUR 17	shells	Sh
NATSUR 6	gravel	G	NATSUR 18	boulder	R
NATSUR 7	pebbles	P			

To write out on the display "Mud Sand Gravel", for example, causes more clutter than writing " M S G". ECDIS manufacturers are encouraged to use the abbreviations both on the chart display and when providing cursor-pick information.

C9.8 Organization of Display << NEW INTRODUCTORY INFORMATION>>

There are several ways that information is organized in ECDIS. They are:

Display Categories

Display Priority

Viewing Groups

Display Categories and Viewing Groups are used to assist the mariner in selecting features to display or filter out of the ECDIS. Display Priorities are not used for selecting features, but to specify which features may obscure or "overprint" features of less importance when they are displayed together. These and other means of organizing the data displayed are described below.

C9.8.1 IMO Display Categories << MAIN 2.3.3a >> <<ANNEX A, 8.3.4.3>>

The IMO "display categories" are as follows:

Standard Display information is the part of the SENC that should be presented when the ECDIS display is first switched on or at any time by a single operator action (see IMO Performance Standards).

Display Base is that part of the Standard Display which should be permanently retained on the display (see IMO Performance Standards).

Other Information includes all SENC information that is not in the Standard Display, to be displayed on demand by the mariner.

The IMO "Standard Display" is the display mode intended to be used as a minimum during route planning and route monitoring (IMO PS). It contains a list of features that the mariner may either add further features to, or remove features (except Display Base) from, in deciding what is to be displayed.

NOTE: As soon as any feature on this list is removed from the display, or any feature not on this list is added to the display, the display no longer shows the IMO "Standard Display".

The IMO "Display Base" is that part of the Standard Display that must never be removed and is not intended to be sufficient for safe navigation. It is a list of basic features which the IMO consider are required at all times, in all geographic areas and under all circumstances.

NOTE: The IMO does not intend the Display Base to be sufficient for safe navigation on its own; therefore it should not be a display option to "Show Display Base" without any additions.

The IMO category "Other Information" contains every feature in the SENC which is not classed as "Standard Display".

The mariner should be able to remove information selectively from "Standard Display", except that they cannot remove any feature of the "Display Base". In addition, they should be able to add selectively to the Standard Display any items of the "Other" category.

The IMO category is part of the ruleset in the S-101 portrayal catalogue and assigns the IMO category in detail to every feature in the SENC, including Mariner's Navigational Features. The mariner may override the category for mariner's features, but not for chart features.

C9.8.2 Mariners Features Display Categories

The own-ship symbol and planned route are always required on the route monitoring display by IMO PS 10.5.1, and so must the Display base. All other mariners' navigational features, which are listed in the portrayal catalogue under "Non-standard classes", are initially assigned in the ruleset to a default "Mariners' Standard" or "Mariners' Other" category. However the mariner should have the option of changing the category of any non-standard feature class (except for Display base), to suit his operational needs.

The following key words in **field 6 of symbology look-up tables** are used to assign the look-up table entries to display categories:

Commentaire [CAH15]: This section will have to be modified, based on the final portrayal model

Category	Description
DISPLAY BASE	*assigns the feature to the Display Base*
STANDARD	*assigns the feature to the Standard Display*
OTHER	*assigns the feature to Other Information*
MARINERS STANDARD	*assigns the feature to Standard Display, or whichever category the mariner assigns them to*
MARINERS OTHER	

C9.8.3 Display Priority & Display Category in Conditional Symbology Procedures << ANNEX A, 8.3.4.5 >>

Commentaire [CAH16]: This section will have to be modified, based on the final portrayal model

A **conditional symbology procedure (CSP)** is called from the look-up tables. Thus, the symbolization that is generated by the procedure has the display priority, OVERRADAR classification and display category which is given in field 4, 5 & 6 of the look-up table entry from which the procedure was called.

A conditional symbology procedure can assign the symbolization to another display category, put it on top of radar or give it a different display priority if necessary. Thus it 'overwrites' the default assignments given in the look-up table e.g. if a depth contour is identical with the safety contour the depth contour is assigned to the DISPLAYBASE category (see symbology procedure diagram 'DEPCNT03', section 12).

The default assignments from the look-up tables are valid if there is no explicit assignment for display category, display priority or OVERRADAR made within the **CSP.**

C9.8.4 Priority Layers << MAIN 2.3.2 >>

Commentaire [N17]: IEC 61174 ref 2.3.2a

The IMO PS divides SENC information into three categories that determine what data is to be on the display: Display Base (always present on the display); Standard Display (the default display); and Other Information (displayed on demand). (IMO PS section 3 and Appendix 2). (See section 2.3.3a).

There are 10 priority layers for the drawing sequence of the data on the display:

1) ECDIS visual alarms/indications (e.g. caution, overscale)
2) HO-data: points/lines and areas, plus official updates
3) NtMs, manual input and Radio Navigational Warnings
4) HO-caution (ENC cautions)
5) HO-colour-fill area data
6) HO's on demand data

7) Radar information
8) Mariners data: points/lines and areas
9) Manufacturer's data: points/lines and areas
10) Mariners colour-fill area data

This list is not intended to indicate a drawing sequence, but to specify that the information content of category n+1 must not obscure the information content of category n, or any higher category (i.e. n-1 etc.).

Category (7) should have a radar off switch to facilitate its removal.

The rulesets and conditional procedures of the portrayal catalogue assign a category, and a display priority (drawing sequence), to every feature (feature class-attribute combination) in the ENC.

Each symbolization instruction from a look-up table line has a display priority given in field 4. The display priority can be of a value between '0' and '9', where '9' identifies the highest priority. The display priority applies irrespective of whether a feature is a point, line or area. If the display priority is equal among features, line features must be drawn on top of area features whereas point features have to be drawn on top of both. If the display priority is still equal among features of the same type of geometry (area, line or point) the given sequence in the data structure of the SENC, or some other neutral criterion, should be used for an arbitrary decision as to which feature is drawn on top. Text should be drawn last (except for ownship etc.), in priority 8.

The display priority should be used to ensure that features that overlap each other are drawn in the right sequence. Thus, a feature with a higher priority should be drawn after (on top of) an feature with a lower display priority. However, if two line features, or two area boundaries, or a line and an area boundary, are located at the same position and share the same extent (their coordinates are identical), then the line symbolization with the higher display priority must suppress the line symbolization of the other feature (line or area). Therefore only the line symbolization of the feature (line or area) of the higher display priority is drawn.

This suppression only applies between line features, which include area boundaries. The rule for centred symbols, area patterns and point symbols is that all symbols should be drawn, with the highest priority feature being drawn last independent of whether it is a point, line or area.

The only exception to this rule for suppressing overlapping lines. The manual chart correction lines LC(CHCRIDnn) and LC(CHCRDELn) should coexist with the underlying line. Both LC(CHCRIDnn) or LC(CHCRDELn) and the underlying line should be drawn.

Overdrawing may be essential, for example in that case of buoy, its name, and its light flare. These are given offsets in the symbol library to avoid overwriting.

The following gives a general indication of how priorities are allocated. Within each group priorities are adjusted to meet specific cases:

Specific Case	**Priority Layer**
No data filled area patter	0
S-101 Skin of the Earth Feature	1
Superimposed areas (e.g. CANALS)	2,3
Restricted area	5
Traffic areas	5

Land features	4,5
Water features	3,4,5,6
Coastline features	5,6,7
Routeing lines	5,6,7
Symbols for lines and areas	4,5,6
Hazards (bridge, safety contour)	8
Mariners VRM and EBL	9
Own Ship	9

C9.8.5 Radar << MAIN 2.3.1d and MAIN 2.3.2.b >>

The radar image may be displayed by an opaque overlay or a transparent overlay, using colour tokens RADHI and RADLO.

The priority of HO chart data over radar is carried out by the single action "remove radar" control (IMO PS 7.2). When present, the radar data always writes over the opaque colour fills. Chart line and point features should normally write over the radar image, with some exceptions, as described in the "over-radar" field of the Presentation Library look-up table. But in order to meet the requirements of IMO PS 11.4.14 to adjust the ship's position, the ECDIS may incorporate the capability of changing the radar priority of the Presentation Library. Operation of this feature should be clearly indicated.

Field 5 of the look-up table lines contains the OVERRADAR flag. It classifies whether features are shown on top of the raw radar picture. Two different values can occur in this field:

'O' which puts the feature's presentation over radar; and

'S' which means that presentation is suppressed by radar

Thus, OVERRADAR is similar to a display layer that assigns features to the information shown on top of the raw radar picture. As a fail-safe, features are automatically OVERRADAR if field 5 of a look-up table line is empty.

C9.8.6 Viewing Groups

The mariner should have effective control over which features appear on the display (subject to the over-riding requirements of IMO category), as required by the IMO ECDIS Performance Standard section 3.5.

The viewing groups suggested in **table XX** are intended as a framework on which the ECDIS manufacturer can base his own method of providing this capability.

Viewing groups are 'on' or 'off' switches for use by the mariner to control the information appearing on the display. An item in the viewing group table may be a chart feature; a mariners' or other time-variable feature; a special symbol such as the "depth less than safety contour" pattern; or a non-ENC feature such as the shallow water pattern. ‘Symbol viewing groups’ allow auxiliary symbols such as

Commentaire [CAH18]: This section will have to be modified, based on the final portrayal model

Commentaire [CAH19]: This section will have to be modified, based on the final portrayal model. The overradar flag will also be defined in the Main Section 9.

Commentaire [CAH20]: This section will have to be modified, based on the final portrayal model. Viewing Groups will also be defined in the Main Section 9.

contour labels, the 'low accuracy' symbol, etc., to be switched on or off without affecting the primary symbolisation of the feature.

Items in the viewing group tables are arranged in numbered groups (e.g. group 26230 consisting of the items pipeline area and cable area) which in turn are arranged in sets (e.g. set 26000 consisting of cautionary areas). The groups are arranged by IMO Category, in the sequence of INT 1 for the paper chart. Mariners are generally familiar with INT 1.

Manufacturers may use the viewing group scheme or not, as they prefer. If it is not used, then in some cases a single item, such as soundings (33010) should probably be selectable. In other cases several groups from different sets may be combined. However groups from different IMO categories should not be combined.

Although the viewing groups reflect the IMO category, the authority for category is the classification in field 6 of the portrayal catalogue ruleset.

Commentaire [J21]: This is an optional thing. Should it remain optional in S-101
Does not need to be made now, but should be part of the test process that tests different products that use different combinations of viewing groups. Also provide guidance to other products using viewing groups.

Commentaire [J22]: Amend when model is finalized

DISPLAY BASE	STANDARD DISPLAY	OTHER INFORMATION
00000-09999 reserved for administrative purposes		
10000 reserved *40000 reserved*	20000 reserved *50000 reserved*	30000 reserved *60000 reserved*
11000 A,B information about the chart display *41000 tools*	21000 A,B 51000 tool	31000 A,B *61000 tools*
12000 C, D, E, F land features *42000 own ship, planned route*	22000 C, D, E, F *52000 own ship etc*	32000 C, D, E, F *62000 own ship etc*
13000 H, I depths & currents *43000 mariners' features*	23000 H,I *53000 mariners' features*	33000 H,I *63000 mariners' features*
14000 J,K,L obstructions, pipelines *44000 other vessels*	24000 J,K,L *54000 other vessels*	34000 J,K,L *64000 other vessels*
15000 M traffic,routes *45000 manufacturers' features*	25000 M *55000 manufacturers' features*	

		35000 M *65000 mfrs' features*
16000 N special areas 46000 mariners' assignments	26000 N 56000 mariners' assignments	36000 N 66000 mariners' assgnts
17000 P,Q,R,S buoys, beacons, lights, radar 47000 reserved for mariners' information	27000 P,Q,R,S 57000 reserved	37000 P,Q,R,S 67000 reserved
18000 T,U services & small craft facilities 48000 reserved for mariners' information	28000 T,U 58000 reserved	38000 T,U 68000 reserved
19000-19999 reserved 49000-49999 reserved	29000-29999 reserved 59000-59999 reserved	39000-39999 reserved 69000-69999 reserved
70000-99999 reserved for future use.		

Notes:

1. These viewing groups reflect the display category, but they do not set it. Display Category is set by field 6 of the look-up table.

2. Gaps between sets and groups are left deliberately to allow for future expansion. "na" means that a particular set or group is not yet assigned (not "populated").

C9.8.7 Text Groupings <<MAIN 2.3.3c >>

Commentaire [N23]: IEC 61174 ref

The ECDIS manufacturer should provide the mariner with control over the selection and display of text on the route monitoring display.

Text should not appear automatically whenever the feature it is associated with appears on the display. It should always be possible to remove text independently of the feature. The IMO Display Category for text is "other".

As a guide to adding and removing text from the display, S-101 distinguishes between "Important text" and "Other text", and provides suggested groupings for text display in Table X.

C9.8.7.1 Display of Text

The display of text should be controlled independently of the display of the feature it applies to. The mariner should have full control over the display of text. All text is in the IMO Category "Other Information".

Text is in colour black, to give best readability under all light conditions.

Text should only be displayed when the feature it applies to is displayed.

Text should always have display priority 8, to ensure it is readable, independent of the feature it applies to.

As a guide to organizing the display of text, the last two digits of the SHOWTEXT instruction give a text classification that distinguishes between "Important" and "Other" text, and gives further suggested text groupings. The manufacturer should provide at least the capability to select "Important Text" and/or "Other Text", and he may provide further text groupings if he so wishes.

NOTE: We need to incorporate the rules for the display on category of name on OBJNAM (now called Name). Basically, if it display name is encode then it is displayed when the instruction for text is clicked on in the ECDIS. Need to have a rule that if display Boolean is not picked then what is the default display. This is most likely a business rule.

The text groupings are:

00-9~~10~~ reserved for future assignment by IHO.

10 Important Text
11 vertical clearance of bridges, overhead cable, pipe or conveyor (BRIDGE, CBLOHD, PIPOHD, CONVYR, VERCSA, VERCLR, VERCCL, VERCOP), bearing of navline, recommended route, deep water route centreline line, recommended track (NAVLNE, RCRTCL, DWRTCL, RECTRC, ORIENT), name and communications channel of radio calling-in point (RDOCAL, OBJNAM, COMCHA).

20 Other text
21 names for position reporting:
name or number (OBJNAM) of buoys (BOYxxx), beacons(BCNxxx), daymarks (DAYMAR), light vessel, light float (LITVES, LITFLT), offshore platform (OFSPLF)
22 na (not allocated)
23 light description string
24 note on chart data (INFORM) or nautical publication (TXTDSC)
25 nature of seabed (NATSUR of SBDARE)
26 geographic names (OBJNAM of SEAARE, LNDRGN etc.)
27 value of: magnetic variation (VALMAG of MAGVAR); swept depth (DRVAL1 of SWPARE)
28 height of islet or land feature
29 berth number (OBJNAM of BERTHS, ACHBRT)
30 na
*31 national language text (NOBJNM, NINFOM, NTXTDS)

32-49 reserved for IHO

50-69 mariners' text, including planned speed etc.

70-79 manufacturer's text

80-99 future requirements (AIS etc.)

* National text is a supplementary option for ECDIS. If used, the style should be similar to that of the Presentation Library.

C9.8.8 Display of features depending on date or display scale <<ANNEX 8.4 >>

C9.8.8.1 Date-dependant features

Some features, such as seasonal buoys, are only to be displayed over a certain period using the complex attribute **periodicDateRange**. Other features, that have a fixed start and end date, such as a traffic separation scheme, will use the complex attribute **fixedDateRange**. During route monitoring, any feature using **periodicDateRange** or **fixedDateRange** should not be displayed outside of its effective dates (see figure 1).

However to provide for effective route planning; for look-ahead during route monitoring; or for other purposes, the ECDIS should allow the mariner to view chart data for any required date and time for the purpose of reviewing pre-planned changes in chart data. The ECDIS manufacturer may provide this either:

By allowing the mariner to select a date for displaying all chart features active at that date and time,

OR

By allowing the mariner to display all features in the ENC, irrespective of the current date. Information on the date and time window for which features of interest are in existence should then be available by cursor-pick report through viewing the date-dependent attributes.

When this option is in use, the mariner must be reminded that the information on the display may not be correct for the actual, current, date and time.

Commentaire [N24]: IEC 61174 ref

Note might change because of using a complex attribute model

C9.8.96 Scale-dependant features

Some features (such as intermediate depth contours) may carry the attribute SCAMIN to specify the smallest display scale at which they should be drawn. At display scales smaller than SCAMIN the feature should not be drawn, in order to avoid clutter. For example, a feature with a SCAMIN value of 50,000, indicating a scale of 1/50,000, should not be drawn on an ECDIS display of 1/60,000.

Commentaire [N25]: This is covered elsewhere in S-101. Should this be moved to the appropriate section.

Needs to be in a general section of S100 portrayal and S-101 can refer back to it. Scale information is an association on the feature and no longer an attribute also add SCAMAX. Keep in this location.

Commentaire [JLP26]: JP: A SCAMIN value of 50,000 is allowed. To avoid confusion, '50,000' should not be used even for an example.

C9.9 Display Components << Provide short new introductory information here >>

C9.9.1 Legend <<ANNEX A 8.6.3 >> <<2.3.1g>>

A standard legend containing at least the following elements should be available for display. It may either be on the same screen as the ECDIS chart display, or on a separate screen.

The following table indicates which ENC data elements must be used. Values, other than those defined in the data set record, should reflect the situation at the own ship's position:

1. units for depth	DUNI subfield of the DSPM field.
2. units for height	HUNI subfield of the DSPM field.
Note on 1., 2. – units for depth and height: although the ENC Product Specification of S-57 does not allow any other than metric depths and heights, these two elements may be stated for the information of unfamiliar users.	
3. scale of display	Selected by user. (The default display scale is defined by the CSCL subfield of the DSPM field or CSCALE attribute value of the M_CSCL feature.)
4. data quality indicator	a. CATZOC attribute of the M_QUAL feature for bathymetric data. b. POSACC attribute of the M_ACCY feature (if

Commentaire [N27]: This needs to be checked against the S-101 8211

	available) for non-bathymetric data.
Note: due to the way quality is encoded in the ENC, both values (a and b) must be used.	
5. sounding/vertical datum	SDAT and VDAT subfields of the DSPM field or the VERDAT attribute of the M_SDAT feature and M_VDAT feature. (VERDAT attributes of individual features must not be used for the legend.)
6. horizontal datum	HDAT subfield of the DSPM field.
7. value of safety depth	Selected by user. Default is 30 metres.
8. value of safety contour	Selected by user. Default is 30 metres.
Note: if the mariner selected a contour that is not available in the ENC and the ECDIS displays a default contour, both the contour selected and the contour displayed should be quoted.	
9. magnetic variation	VALMAG, RYRMGV and VALACM of the MAGVAR feature. Item must be displayed as VALMAG RYRMGV (VALACM) e.g., 4°15W 1990 (8'E).
10. date and number of latest update affecting chart cells currently in use.	ISDT and UPDN subfields of the DSID field of the last update cell update file (ER data set) applied.
11. edition number and date of the ENC.	EDTN and UADT subfields of the DSID field of the last EN data issue of current ENC issue of the ENC set.
12. chart projection	Projection used for the ECDIS display (e.g., oblique azimuthal).

The list above is the minimum that should be available, but the complete list need not always be shown. Individual items might be picked by the mariner for display for a period; examples are magnetic variation, data quality for depths (M_QUAL, CATZOC) etc.

C9.9.2 Graphical Index << MAIN 3.1.7 >>

Commentaire [N28]: IEC 61174 ref

This section will change and it is also covered elsewhere in S-101.

1.) Graphical Index of ENCs by Navigational Purpose. Without cursor enquiry of the chart area it will not always be clear what compilation scale applies to a given part of a mixed source display. S-52 requires a graphical index of the navigational purpose of the data to clarify the situation. This is also needed for route planning.

2.) Limit of HO data. The end of HO chart data on this graphical index defines the limit of HO ENC coverage. Details are given in the Presentation Library, Part 1, section 12.2.2 DATCVR.

C9.9.3 Display Orientation << MAIN 3.1.6 >> << 7.2.3 >>

It should always be possible to display the chart north-up (IMO PS section 8.1), but other orientations are allowed.

Symbols and text should always be drawn screen-up, no matter what the orientation of the screen may be. Symbols which include "rotate" in the symbology instruction (e.g., light flares) should be rotated with respect to the top of the screen. However, symbols that are oriented according to an S-57 attribute such as ORIENT should be oriented with respect to true north. Symbols with no rotation should always be drawn upright with respect to the screen.

Symbols with a rotation instruction should be rotated with respect to the top of the screen.
Symbols rotated by means of the six-character code of an S-57 attribute such as ORIENT should be rotated with respect to true north.

Symbols should be rotated about their pivot point. Rotation angle is in degrees clockwise from 0 to 360. The default value is 0 degrees.

If the display is oriented course-up, the orientation should not be altered too frequently, in order to avoid jitter from frequent rewriting of chart information.

The north arrow is always required on the display, as part of the IMO Performance Standards Display Base.

C9.10 Types of ECDIS Symbols << Main, 3.2 & 3.3 >>

Commentaire [N29]: IEC 61174 ref

C9.10.1 Adaption of Traditional Paper Chart Symbols

Most of the symbols in IHO INT 1, *Symbols, Abbreviations, Terms used on Charts* have been adapted for use in ECDIS. The ECDIS Chart 1, which is divided into lettered sections in the same way that INT 1 is, provides a quick reference for the symbols.

For light sectors, the mariner shall be able, upon request to the ECDIS, be capable of identifying the colour of the sectors affecting the ship, even if the lights involved are off the display.

C9.10.2 ECDIS only symbols << Adapted from Main, 3.2 >>

There are four types' symbols that are only found on ECDIS, which are described below.

1) Special ECDIS chart symbols to identify unsafe depths, such as the safety contour, safety depth, isolated dangers etc.

2) Symbolized area boundary linestyles.

On a large scale display, the boundary lines of areas can become confusing; symbolised area boundaries identify the type of area and also indicate on which side of the boundary line the area lies.

The ECDIS should provide mariners with the option of using either the symbolized or the plain area boundary linestyles, as best fits their purpose. The symbol tables of the Presentation Library are organised to facilitate these options.

Commentaire [CAH30]: This section will have to be modified, based on the final portrayal model.

3) New chart symbols, such as north arrow, scale boundary, depth area less than safety contour, etc., which are needed to explain the more flexible, electronic display based, presentation of ECDIS.

C9.10.3 Special ECDIS Symbols to Identify Unsafe Depths << Adapted from Main, 3.2.2 >>

Commentaire [N31]: IEC 61174 ref

The ECDIS highlights in new ways four features that are important for safe navigation. These are the safety contour, depth shades, the safety depth and isolated dangers:

1) The own-ship safety contour, selected by the mariner from among the contours in the SENC, is double-coded by a thick line and a prominent change in depth shade.

If the safety contour selected by the mariner is not available in the SENC, the ECDIS must~~shall~~ default to next deeper contour and inform the mariner. If, when the ship moves onto a new chart, the safety contour previously in use is no longer available, the ECDIS ~~shall~~ must select the next deeper contour available, and inform the mariner.

If the mariner does not select a safety contour, the value should default to 30 m.

2) Depth zone shades, defined by the safety contour and selected shallow and deep contours and the drying line.

The safety contour defines two depth zone shades and the drying line a third:

deep water:	deeper than the safety contour (colour token DEPDW),
shallow water:	shallower than the safety contour (colour token DEPVS),
intertidal area:	area exposed at low water (colour token DEPIT).

These are the only three depth shades that can be clearly distinguished on the night display, and they can only be distinguished by contrast, when seen on the display together. If, at night, the entire display consists of shallow water, the mariner will not be able to recognise this dangerous situation. Therefore, a "depth less than safety contour" pattern is provided to reinforce the depth shade. It is optional for the manufacturer to provide this feature, but its inclusion is strongly recommended as a safety feature.

The mariner should be given the option of whether to use this pattern, by night or by day (although it is not strictly necessary by day when the shallow water can be clearly identified by the difference in depth shade). This mariner's option is built into conditional symbology procedure "SEABEDnn". See Presentation Library , sections 8.5.7 and 12.2.18.

Commentaire [CAH32]: This CSP is to be replaced with logic encoded in XML.

It is recommended that the ECDIS should also allow the mariner the option of selecting a deep contour and a shallow contour from among the contours in the SENC, thus establishing the following five depth zones:

deep water:	deeper than the deep contour (colour token DEPDW),
medium-deep water:	depths between the deep contour and the safety contour (DEPMD),
medium-shallow:	depths between the safety contour and the shallow contour (DEPMS),
very shallow water:	depths between the shallow contour and zero metre contour (DEPVS)
drying foreshore:	intertidal area (DEPIT)

The following depth zones may be used as default values:

deep water:	deeper than 30 m (deep draught vessels)
medium deep:	own-ship safety contour to 30 m
medium shallow:	2 m to the own-ship safety contour
very shallow:	0 to 2 m (defines waters accessible to small craft)
intertidal:	exposed at low water

3) The own-ship safety depth is intended as an aid when no appropriate safety contour is available in the SENC. Soundings equal to or less than the safety depth selected by the mariner are made more conspicuous than deeper soundings. A separate set of sounding figures is provided in the Hydro Portrayal Register.

4) Isolated dangers (small shoals, rocks, wrecks, obstructions) of depth less than the safety contour, and also lying within the 'safe' water defined by the safety contour, are highlighted by a special symbol. Because the mariner may sometimes have to navigate in water shallower than a default safety contour, the mariner may also select to show isolated dangers in the 'unsafe' water between the displayed safety contour and the zero metre contour.

These procedures are found in the portrayal catalogue

C9.10.4 Symbolised and Plain Area Boundary Linestyles. << Main, 3.1.1 >>

C9.10.4.1 Mariner's options for linestyles << MAIN 3.1.1 >>

The mariner mustshall be able to optionally select to display symbolised area boundary linestyles, which are more useful for large scale displays, or plain linestyles, which are recommended for small scale displays, where symbolised lines would cause clutter. Two look-up tables are provided, to display either symbolised or plain area boundary linestyles.

New chart symbols required by the difference in purpose between ECDIS and the paper chart, as well as the difference between paper and electronic presentation, are described below.

C9.10.5 Unique ECDIS Symbols << Adapted from Main, 3.2.3(2) – (21) >>

Commentaire [N33]: IEC 61174 ref

1) General symbol for isolated underwater danger.

   The conspicuous magenta “screw head” symbol is applied automatically to rocks, wrecks, small shoals, etc., of depth equal to or less than the own-ship safety contour and which are in deeper water than the safety contour. Optionally, the mariner may extend displaying isolated dangers to shallow waters between the safety contour and the zero metre contour, in case he is forced by circumstances to navigate in such waters.

2) The dredged area is shown by a grey dotted area fill pattern.

3) Radar conspicuous coastline.

   This includes cliffs and abrupt coastlines that can be expected to return a strong radar echo consistently from the same part of the feature. The magenta highlight line is only used if the coastline is identified as "radar conspicuous" in the ENC.

4) Prohibitions, cautions and information notes are symbolized with small symbols for point application and with large centred symbols for areas, as illustrated in screens (AB), (JKL) and (MN) of the ECDIS Chart 1. Multiple symbols are used when necessary to convey more than one restriction.

   Regulated areas are divided for symbolization into Cautionary Areas (including the existing caution area) and Information Areas. (See Table 4 of this document).

   Point cautions and notes entered by the mariner and the manufacturer are distinguished by the colours orange and yellow respectively.

5) Unknown feature.

   A magenta "?" marks the position of a feature which cannot be identified or for which there is no entry in the Presentation Library look-up table.

6a) Scale boundary.

This shows where the compilation scale of the chart data available changes. The ECDIS should warn the mariner of upcoming chart scale change. Only the major changes in compilation scale resulting from a change in "navigational purpose" should be shown. Small changes in compilation scale within a navigational purpose should not be shown. See Presentation Library, Part I, section 12.2.2 DATCVR for details.

Commentaire [N34]: Need to change to reflect mindsc and maxdsc

6b) Overscale area at scale boundary.

All the chart data on the display must be shown at the same scale. In order to avoid leaving part of the display blank, the chart display may extend beyond the edge of a relatively large scale ENC to include information from an adjoining smaller scale ENC, which may be from a different "navigational purpose". The smaller scale data will normally be enlarged to match the larger scale ENC, and in this case the "overscale area" symbol should be used to identify any part of the chart display shown at more than twice the compilation scale. See Presentation Library, Part I, section 12.2.2 DATCVR for details.

Commentaire [N35]: Need to change based on dataset loading and unloading and overscale algorithm

NOTE: This symbol applies only to the automatic overscaling performed by the ECDIS in matching ENCs at different compilation scales. It should not be applied to an overscale display deliberately requested by the mariner, which should trigger the overscale indication required by IMO Performance Standard section 6.1.1.

6d) Change of horizontal (geodetic) datum.

The use of non-WGS 84 ENC data does not comply with IHO S-101, and the boundary at which the local geodetic datum changes is not symbolized by the Presentation Library.

The ENC may include information on the relation between the local geodetic datum and WGS 84 (M_HDAT, HORDAT), but this is intended for use in converting local data to WGS 84 for use in the SENC, should the need arise.

7) Scale bar or latitude scale.

The IMO PS requires an indication of scale and range as part of the Display Base. The display scale decides which should be used:

(a) for optimum scales larger than 1/80,000: always display the 1 mile scale bar provided in the Presentation Library

(b) for optimum scales at 1/80,000 or smaller: always display the 10 mile latitude scale provided in the Presentation Library.

The scale bar or latitude scale should always be drawn vertically at the left side of the chart display, just clear of the border of the display.

The mariner should be able to remove any labels on the scales to avoid clutter.

Optimum scale is defined as one twelve values in Clause 3 of S-101. These values have been aligned to the standard RADAR ranges.

8) North arrow.

The IMO PS requires a north arrow as part of the Display Base. The north arrow should always be shown at the top left corner of the chart display, just clear of the scale bar or latitude scale.

9) Manual chart correction.

Small orange identifiers are used to distinguish hand-entered chart corrections, which are subject to human error, from corrections entered automatically by electronic means. The original chart feature should not be removed or altered. (See 2.3.4 for details).

Commentaire [N36]: IEC 61174 ref S-52 ed 6.0 2.3.4

10) Ramark, Racon.

This is introduced to distinguish beacons that will appear on the radar display from other radio-beacons.

11) Data from non-HO sources

The non-HO data boundary LC(NONHODAT) serves to separate ENC data from non-HO chart information.

12) No data areas.

The first action of the ECDIS display re-draw should be to cover the entire screen with the NODTA area colour fill and the AP(NODATA03) area pattern. These will remain to identify any area not subsequently covered by chart information as a no data area.

13) Identifying pattern for depth areas less than the safety contour.

14a) Identifying pattern for traffic junctions, crossings and roundabouts.

A pattern of diagonal magenta lines is used to identify the areas of a traffic separation scheme which are traffic junctions, crossings or roundabouts, or precautionary areas.

14b) Traffic routeing and regulated areas in general.

New centred symbols are provided in the Portrayal Catalogue, to avoid the clutter caused by a pattern of symbols in these often critical waters.

15) Glacier or ice shelf.

A random pattern of short lines symbolising "candled" ice is provided to indicate a glacier or area of shore-fast ice.

16) Daymark.

The daymark symbols are designed so that they can be over-written on a beacon which is highlighted by a daymark.

17) Paper chart symbols for an opening bridge and a radar reflector on an overhead cable have been revised to fit any orientation of the bridge or cable - see ECDIS Chart 1.

18) A one-sided linestyle is provided for use on large-scale displays to indicate the side of an area boundary on which the area lies, when only a part of the boundary can be seen on the display.

19) Meta-data (information about the chart data), such as chart data confidence areas.

The "zones of confidence " in the chart data (section 3.1.8) are symbolised by a system of stars. Other meta-data items, including compilation scale, IALA "A" or "B" buoyage, etc, are left to cursor picking.

20) Special identifiers.

In addition to the manual chart correction identifier of para. (11) above, identifiers are provided for low accuracy chart data and for ENC features which have additional information for cursor picking

under the "INFORM" attribute. The latter may cause clutter, and should only be displayed temporarily. Identifiers are shown on screen (AB) of the ECDIS Chart 1.

21) IEC symbols.

By agreement with the IEC, symbols for the "Navigational Elements and Parameters" of the IMO PS Appendix 3, and also symbols being developed by IMO for AIS vessel reports, are included in the Presentation Library. These are on the last diagram of the ECDIS Chart 1.

C9.10.6 Mariner's Features << Adapted from Main, 2.3.1a >>

Commentaire [N37]: IEC 61174 ref

IMO PS section 1.5 requires that ECDIS distinguish between chart data and additional data from users (mariners) and manufacturers. The following colour and symbol usage for mariners and manufacturers data is designed to implement this while ensuring the display remains clear and uncluttered.

Clause X.X.X of this annex describes "Mariner's Navigational Features" for route planning and route monitoring chartwork, and for adding mariner's and manufacturer's information to the SENC. The descriptions are in the same format as chart features, in order to avoid the ECDIS having to deal with two differently coded types of data. The colours, symbols, categories and display procedures that apply to all these features are included in the portrayal cataloguer, along with the procedures for chart features.

Mariners may alter the IMO categories for Mariner's Features (but not for chart features).

NOTE: IMO PS 11.4.1 requires that own ship and selected planned route should always appear, and should therefore remain in Display Base.

NOTE: Mariner's Features should be kept independent of chart data in the SENC, and that mariners' information does not need to be split into datasets.

In referring to Mariner's Features it is important to distinguish between:

"Add/Enter", "Revise" or "Delete" mariner's or manufacturer's information; this refers to the contents of the SENC, and:

"Display" or "Remove" the information; this refers to the ECDIS display.

C9.11 The Portrayal Display

C9.11.1 Introduction << MAIN 3.1.3 >>

Commentaire [N38]: IEC 61174 ref

All symbols are specified in the Hydro Portrayal Register.

Some feature classes do not have a symbol (e.g. territorial sea). Such "no symbol" features may be picked up by cursor interrogation of the area.

Should an "unknown feature" occur in the SENC which is not adequately defined or for which no symbol exists, its presence should be indicated on the display by a magenta"?" SY(QUESMRK1) with the IMO category "Standard Display".

Some features are symbolised differently depending on circumstances (for example the symbol for a contour depends on whether it is the safety contour.) The Presentation Library includes conditional symbology procedure diagrams for features whose symbols cannot be supplied by a fixed look-up table. Some of these procedures are unavoidably complex, and they should be evaluated carefully.

Commentaire [CAH39]: Will need to describe how the CSP logic will be specified in S-100.

C9.11.2 Symbols << ANNEX 1.1 >>

The symbols of the Hydro Portrayal Register may be replicated in size and shape, using any convenient format. The colour tables may be reproduced within the tolerances given in the portrayal catalogue. The remaining items may be implemented in any convenient form which produces the same results as the Presentation Library.

It is also required that the ECDIS be able to read in the set of symbols, colour tables, and other items in the portrayal catalogue. This is to ensure that if new features and symbols are required they can be updated via the S-101 feature and portrayal catalogue so that the mariner may receive the updated catalogues in an expedient manner.

C9.11.2.1 Minor Symbol Deviations <<Adapted from Main 1.4.6>>

Minor deviations by ECDIS manufactures in the implementation of the symbols specified in this document and the Portrayal Register are permitted to allow for innovation and responsiveness to ECDIS users. However, only minor changes are allowed and all symbols must be easily recognizable as the respective symbol in the Portrayal Register. The following criteria shall be used to determine whether any symbolization on an ECDIS that is different from the symbolization in Portrayal Register is still compliant. The symbolization used should:

1.) be the same in general shape and size as the IHO version;

2.) be clear and sharp so that there is no uncertainty over meaning;

3.) be close enough to the IHO version to avoid ambiguity in meaning between that model and any other model of ECDIS;

4.) use only the colours as specified in S-100;

5.) comply with the various considerations of scientific design described in S-100;

6.) comply with the priority of prominence on the display in proportion to importance to safety of navigation which as provided in the Portrayal Register, and

7.) avoid any increase in clutter.

C9.11.2.2 Other Special Symbols

1.) Additional information Indicator (INFORM01) << ANNEX A 8.6.1 >>

Commentaire [N40]: This will need to be updated to reflect that this is part of a complex attribute.

HOs may apply the INFORM attribute to any feature to carry information that cannot be coded in S-101 format, such as a warning for a traffic junction, an abstract from a nautical publication, a pictorial representation of an feature, etc. There are a total of five similar universal attributes:

INFORM

NINFOM (INFORM text in national language) *

TXTDSC

NTXTDS (TXTDSC text in national language)

PICREP (Pictorial representation)

To identify features with such additional information, the ECDIS should, on mariner's command, identify all features having any such attribute populated by means of SY(INFORM01). The mariner should then be able to access the information by cursor-pick.

The pivot point of SY(INFORM01) should be placed at the position of a point feature, at the midpoint of a line feature, or at the centre of an area feature. SY(INFORM01) is intended as a temporary overlay. Its display priority is 8, overradar, category other, viewing group 31030.

The ECDIS manufacturers should provide appropriate solutions that enable PICREP and other files to be displayed without affecting night vision. (Note: this applies as of September 2001 – particular technical standards may be applied at a later date if found necessary).

2.) 'Cautionary' and 'Information' Areas << MAIN Table 4 >>

The cautionary area / information area distinction is reflected in the IMO PS Appendix 4 "Areas for which special conditions exist". It is the basis for symbolising those areas which do not have a specific symbol with either a "(!)" for a cautionary area or a "[i]" for an information area:

Information areas - Standard Display:

anchorage area (ACHARE)
anchor berth (ACHBRT)

dumping ground (DMPGRD)

fishing ground (FSHGRD)
pipeline area (PIPARE)
cable area (CBLARE)

cargo transhipment area (CTSARE)
incineration area (ICNARE)

specially protected areas – sanctuaries, etc. (RESARE CATREA 4, 5, 6, 7,10, 18, 20, 22, 23, 27, 28)
no wake area (RESARE CATREA 24)

Cautionary Areas:

Routeing areas - Standard Display:

Traffic separation zone (TSEZNE)
Traffic routeing scheme crossing or roundabout (TSSCRS, TSSRON)
Traffic routeing scheme precautionary area (PRCARE)
Two-way traffic route (TWRTPT)
Traffic separation scheme lane (TSSLPT)
Deepwater route (DWRTPT)
Recommended traffic lane (RCTLPT)
Inshore traffic zone (ISTZNE)

Other cautionary areas - Standard Display:

fairway (FAIRWY)
area to be avoided (RESTRN 14)
entry prohibited/restricted (RESTRN 7, 8)
anchoring prohibited/restricted (RESTRN 1,2)
fishing/trawling prohibited/restricted (RESTRN 3, 4, 5, 6)
caution area (CTNARE)
waiting area (RESARE CATREA 19)
swinging area (RESARE CATREA 25)
ferry area (FERYRT)
navigation aid safety zone (RESARE CATREA 12)

offshore production area (OFSPRD)
offshore safety zone (RESARE CATREA 1)
minefield (RESARE CATREA 14)
submarine transit lane (SUBTLN)
military practise area (MIPARE)
military area (RESARE CATREA 9)
degaussing area (RESARE CATREA 8)
seaplane landing area (SPLARE)

3.) Display of updates (manual and automatic)

4.) Chart Data Quality Indicator << MAIN 3.1.8 >>

A bathymetric data quality indicator by zones of confidence (M_QUAL CATZOC) will cover the entire area of depth data or bathymetry for the ENC. The table of "CATZOC" values giving the meaning of each zone of confidence should be readily available to the mariner.

C9.11.3 Displaying of Manual and Automatic Updates <<Annex 8.7>>

For guidance on updating the ENC, see Appendix 1. This section deals with how updates should be displayed. It is keyed to the relevant sections of the IMO PS.

IMO PS 4.5 Automatic and semi-automatic updates: these should be displayed in the same manner as ENC information, using standard colours and symbols.

IMO PS 4.8 The mariner should be able to display updates for review as follows:

For automatic updates: the manufacturer should provide a means of distinguishing these from each other. One method suggested is to identify automatic updates temporarily in the same manner as manual updates. The temporary switch-on/switch-off of the identifiers would distinguish automatic from manual updates.

For manual updates: Display all SENC information and should be distinguishable from each other.

C9.11.3.1 Manual Updates <<Annex 8.7.1>> <<2.3.4>>

Commentaire [J41]: IEC 61174 ref

Manual updates of ENC information should be displayed using the same symbology as ENC information and should be distinguished from ENC information as follows:

C9.11.3.2 Added feature: <<Annex 8.7.1.1>>

Point feature: superimpose SY(CHCRIDnn)*

Line feature: overwrite with line LC(CHCRIDnn)*

Area feature: overwrite area boundary with line LC(CHCRIDnn) and superimpose SY(CHCRIDnn) on any centred symbol.

C9.11.3.3 Deleted feature: <<Annex 8.7.1.2>

The feature should remain on the display and should be marked as follows:

Point feature: Superimpose SY(CHCRDELn)*

Line feature: Overwrite with line LC(CHCRDELn)* (do not remove the original line)

Area feature: Overwrite area boundary with line LC(CHCRDELn) and superimpose SY(CHCRDELn) on any centred symbol.

*SY(CHCRIDnn) means the current version of symbol CHCRID, i.e., CHCRID01 in 1997. CHCRID and CHCRDEL symbols have the category and viewing group of the feature they are attached to, display priority "8", radar priority "O".

Commentaire [CAH42]: New model will change this

Note that the line symbols LC(CHCRIDnn) and LC(CHCRDELn) should not suppress the underlying line (see section 8.3.4.1).

C9.11.3.4 Moved feature: <<Annex 8.7.1.3>>

As for deleted feature, followed by added feature.

C9.11.3.5 Modified feature: <<Annex 8.7.1.4>>

a) If the only modification is an addition (e.g., an existing buoy has a retro-reflector added with no other change): superimpose SY(CHCRIDnn) or LC(CHCRIDnn)

b) If the only modification is a deletion of a part (e.g., an existing buoy has a fog signal removed, or an area has a «fishing prohibited» restriction removed), then this creates both a change and a deletion and both should be symbolized:

Point: superimpose SY(CHCRIDnn) and SY(CHCRDELn)

Line: overwrite with LC(CHCRIDnn) and LC(CHCRDELn)

Area: overwrite the boundary with LC(CHCRIDnn) and LC(CHCRDELn) and also superimpose SY(CHCRIDnn) and SY(CHCRDELn) on any centred symbol.

c) If the modification is an addition and a deletion then it is handled as in 9.4.4.4 b above.

A deleted feature must appear on the display only when its IMO category and viewing group are displayed.

S-52 Appendix 1 requires that a manually updated feature must be capable of the same performance in feature selection, response to cursor-picking, etc., as an ENC feature. In addition, it must provide updating information (identification and source of update, when and by whom entered, etc.) on cursor picking.

Commentaire [N43]: What about Appendix 1. Do we just incorporate the relative stuff into S-101

C9.11.3.6 Identifying automatic chart corrections on mariners demand <<Annex 8.7.1.5>>

The ECDIS manufacturer must provide a means of identifying automatic chart corrections to the SENC on demand by the mariner.

C9.11.4 Displaying added chart information <<Annex 8.7 & Main 2.3.1>>

C9.11.4.1 Non-HO (non-ENC) Chart Information <<Annex 8.7.2>>

Commentaire [N44]: IEC 61174 ref

If the manufacturer should add non-HO (non- ENC) chart information to the SENC it should be symbolised in the same way as HO chart information and distinguished from HO chart information as described for the various cases below:

Limited non-HO data is added to existing HO data to augment the chart information. Each feature

should be marked by the special identifiers described in the Presentation Library, section 8.7.2.

An area of non-HO data is located in waters for which HO chart data exists; it is superimposed on the HO data. In some cases the non-HO data may be more appropriate for the intended purpose, for example it may be more detailed.

In this situation it is at the mariner's discretion whether to use the HO or the non-HO data.

If the mariner selects the non-HO data, the boundary of this data should be identified on the ECDIS display by the line LC(NONHODAT) and the warning "Unofficial data displayed; refer to official RNC or paper chart" should be displayed.

Note that the LC(NONHODAT) is a "one-sided line", and the boundary of the area of non-HO data must be drawn according to S-57 rules to ensure that the diagonal stroke of the line is on the non-HO data side of the line. More details are given in PresLib section 12 conditional symbology procedure DATCVR section 2.1.

Commentaire [JLP45]: JP: More details are given in Presentation Library section 12 conditional symbology procedure DATCVR section 2.1.

ED NOTE: This should refer back to S-101? Need to consult DIPWG

An area of non-HO data is located wholly outside the area covered by HO data (although it may share a boundary with the HO data) but is shown on the same display as HO data. The non-HO data should be bounded by the line LC(NONHODAT) and the warning "Unofficial data displayed; refer to official RNC or paper chart." should be displayed.

The entire display contains nothing but non-HO data. The warning "No official data available; refer to official RNC or paper chart." should be displayed. In this case, special identifiers need not be used."

C9.11.4.2 Distinguishing between HO and non-HO data <<Annex 8.7.2>>

Non-HO data added to existing HO ENC data by mariners or manufacturers to augment the chart information must be distinguished from the HO-ENC information as follows: <<Annex 8.7.2.1>>

Point feature: superimpose SY(CHCRIDnn)

Line feature: overwrite with line LC(CHCRIDnn)

Area feature: overwrite area boundary with line LC(CHCRIDnn) and superimpose SY(CHCRIDnn) on any centred symbol.

Distinguishing non-HO data from manually updated chart information, which uses the same identifiers, must be enabled through cursor picking.

C9.11.4.3 Manufacturer's Information on the route monitoring display <<Main 2.3.1.c >>

Commentaire [N46]: IEC 61174 ref

In addition to the requirements of 9.10.2 above, the following is also required for manufacturer added chart and non-chart data.

C9.11.4.4 Updating and removing Non-HO chart information <<Annex 8.7.2.2 & 8.7.2.3>>

Non-HO chart information may be updated by any systematic procedure. A record of updates must be maintained. The mariner must be able to remove all non-HO chart information if the need should arise.

C9.11.4.5 Added non-chart information <Main 2.3.1.c.1 >>

All non-chart information added to the SENC by the manufacturer must use the following symbols, lines and areas:

The circled (!) caution symbol SY(CHINFO11), or boxed [i] information symbol SY(CHINFO10), used to call up a note on the alphanumeric display by cursor picking,simple lines, or areas without colour fill,

set up for cursor picking to give an explanatory note in the alphanumeric display (colour fill must not be used).

Non-chart information entered by the manufacturer must be distinguished by the colour yellow (colour token ADINF). It must not overwrite HO ENC information.

C9.11.4.6 Added chart information << Main 2.3.1.c.2>>

Commentaire [N47]: IEC 61174 ref

All non-HO (non-ENC) chart information added to the SENC by the manufacturer must be symbolised in the same way as HO chart information and distinguished from HO chart information as described for the various cases below:

1.) An area of non-HO data is located in waters for which HO chart data exists; it is superimposed on the HO data. In some cases the non-HO data may be more appropriate for the intended purpose, for example it may be more detailed.

In this situation it is at the mariner's discretion whether to use the HO or the non-HO data.

If the mariner selects the non-HO data, the boundary of this data should be identified on the ECDIS display by the line LC(NONHODAT) and the warning "Unofficial data displayed; refer to official RNC or paper chart" should be displayed.

NOTE: The LC(NONHODAT) is a "one-sided line", and the boundary of the area of non-HO data must be drawn according to **S-101** rules to ensure that the diagonal stroke of the line is on the non-HO data side of the line.

2.) An area of non-HO data is located wholly outside the area covered by HO data (although it may share a boundary with the HO data) but is shown on the same display as HO data. The non-HO data should be bounded by the line LC(NONHODAT) and the warning "Unofficial data displayed; refer to official RNC or paper chart." should be displayed.

3) The entire display contains nothing but non-HO data. The warning "No official data available; refer to official RNC or paper chart." should be displayed. In this case, special identifiers need not be used."

C9.11.5 Mariner's Navigational Features << MAIN 2.3.1a >>

Commentaire [N48]: IEC 61174 ref

The Portrayal Catalogue describes "Mariner's Navigational Features" for route planning and route monitoring chartwork, and for adding mariner's and manufacturer's information to the SENC. The descriptions are in the same format as chart features, in order to avoid the ECDIS having to deal with two differently coded types of data.

Mariners may alter the IMO categories for Mariner's Features (but not for chart features). Note, however, that IMO PS 11.4.1 requires that own ship and selected planned route should always appear, and should therefore remain in Display Base.

NOTE: Mariner's Features should be kept independent of chart data in the SENC, and that mariners' information does not need to be split into cells.

In referring to Mariner's Features it is important to distinguish between:

"Add/Enter", "Revise" or "Delete" mariner's or manufacturer's information; this refers to the contents of the SENC, and:

"Display" or "Remove" the information; this refers to the ECDIS display.

C9.11.6 Mariner's Information on the route monitoring display << MAIN 2.3.1b >>

Commentaire [N49]: IEC 61174 ref

In addition to the ability to enter manual chart corrections and to carry out route planning and route monitoring chartwork, the mariner must be provided with the capability of adding at least the following symbols, lines and areas to the SENC, and should be able to revise or delete them:

1. the caution "(!)" or information "[i]" symbol **section 3.2.3 (6b), (6c),** used to call up a note on the text display by cursor picking,

2. simple lines and areas with or without colour fill, set up for cursor picking to give an explanatory note in the text display,

3. any of the chart symbols in the S-101 Symbol Catalogue,

4. text notes.

Non-ENC chart information added by the mariner should be in normal chart colours.

Other information added by the mariner should be distinguished by the colour orange (colour token NINFO) except for colour fill, which should use transparent yellow (colour token ADINF). (Transparent orange tends to look magenta in colour over blue backgrounds).

Mariner's information should not overwrite ENC information.

C9.11.7 Text

C9.11.7.1 Text as part of the route monitoring display << MAIN 3.4.1 >>

Text information should be used on the route monitoring display only when unavoidable, since it has to be written large to be readable and so causes clutter.

Soundings are treated by the Presentation Library as symbols to ensure they are legible and correctly located.

C9.11.7.2 Light description text strings << ANNEX A 8.6.4 >>

The mariner may need to label all lights with a description in order to identify those he can see. A mariner-optional light description text-string is provided for this purpose, as a required sub-procedure of conditional symbology procedure LIGHTS.

Commentaire [J50]: Included a display of text earlier in this annex. Should it really go hear or a note to refer to the above.

CLARIFY LANGUAGE

C9.11.7.3 Text windows, explanatory diagrams etc. superimposed on the route monitoring display << MAIN 3.4.2 >>

Commentaire [N51]: IEC 61174 ref

The 270 mm by 270 mm minimum area of chart presentation for route monitoring should normally be used for chart and navigation information alone.

Any windows containing text, diagrams, etc., superimposed on the route monitoring display should be temporary, and should not obscure important chart or navigational information. Such windows should use only the "User Interface" colours from the Portrayal Catalogue. It should be possible for the mariner to re-locate a window in a less important part of the display, such as on land, or behind the ship.

C9.11.7.4 Separate text panel on the same screen as the route monitoring display <<MAIN 3.4.3 >>

Commentaire [N52]: IEC 61174 ref

A Mariner's Information Panel, consisting mainly of text (alphanumerics), may~~might~~ include:

ECDIS alarms and indications, e.g." crossing safety contour",

navigation information, e.g. time, position, course to make good, etc.,

chart information, e.g. contour selected for own-ship safety contour,

supplementary chart information, e.g. tide tables, sailing directions,

interface dialogue, e.g. "change to night colour table".

etc.

The text panel should be outside the 270 by 270 mm minimum area designated for the route monitoring chart display by the IMO PS. The colours, symbols and luminance of this user interface panel should not degrade the SENC information on the chart display.

At night it is essential that any interface panel or other information added by the manufacturer to the screen carrying the chart display should never generate more light than the chart display itself. Great care is taken to reduce the light emitted by the chart in order to preserve the mariners night vision, and it is dangerous to ship safety if added non-chart information defeats that purpose.

It is particularly important to limit the information shown using the conspicuous colour token "UINFD", which is reserved for important information. Even a small panel of text in this colour can produce more light on the bridge than the entire route monitoring chart display.

C9.11.7.5 Text shown on a separate auxiliary screen

A separate screen may be provided for text display, either instead of or in addition to a panel on the main screen used for the route monitoring display. The presentation on this auxiliary screen need not follow these specifications in detail, but should conform in general, to avoid confusion, and should meet the same bridge lighting constraints.

All information displays should be designed in accordance with ergonomic principles.

C9.11.8 Pick Reports <<MAIN 2.3.1e and ANNEX A 8.8.1 >> <<3.1.2>>

Commentaire [J53]: IEC 61174 ref

<< This section will be augmented with ideas from Richard Coombes' Grand Unified Theory of Pick

Commentaire [N54]: IEC 61174 ref

It should be possible to call up any of the information associated with an object by cursor enquiry on its symbol. This should extend to areas (restricted area, depth area, etc.) and to "no symbol" areas (territorial seas, etc.) and meta-areas (information about the area such as compilation scale, etc.). The search for area information needs to extend only to the cell boundaries enclosing the position of the cursor.

C9.11.9 IMO Presentation Instructions Not Handled by Look-up Tables <<ANNEX A, 8.5 >>

In some cases the Presentation Library does not provide a symbology instruction in the look-up tables or flow chart of a conditional symbology procedure that specifies how to present a specific feature on the ECDIS screen. The reason is, that such a feature cannot be clearly identified as an S-57 feature class or it appears to be illogical to include it to the mariners' navigational feature classes (see Part II for further details and definitions of the mariners' navigational feature classes).

Therefore, the following presentation instructions are in free text in order to assist the manufacturer to set up a satisfactory and comprehensive ECDIS display. The manufacturer can achieve a correct presentation by handling these cases in his software individually. All symbols, line styles or fill pattern mentioned in the text are in the portrayal catalogue.

C9.11.10 Detecting the Safety Contour

IMO Performance Standards for ECDIS requires that "ECDIS should give an alarm if the ship, within a specified time set by the mariner, is going to cross the safety contour".

The ENC may not contain any contours round small isolated dangers. However conditional symbology procedure UDWHAZ identifies all rocks, wrecks and obstructions that require a safety contour, and the output of this procedure through calling procedures OBSTRN and WRECKS may be used in generating alarms. One feature, LNDARE as a point (islet) or line (isthmus) is not covered by procedure UDWHAZ; it should be added to the safety contour detection process as a separate item..

Commentaire [JLP55]: JP: When we encode the breakwater of the line type, we use only the SLCONS as a line. (We don't use the LNDARE(L).

Therefore, we propose that the SLCONS should be included in this sentence.

ED NOTE: Need to refer back to DIPWG as it is referencing a CSP

C9.11.10.1 Scalebar and latitude scale:

For optimum scales larger than 1/80,000 (e.g. a scale of 1/50,000) draw symbol 'SCALEB10' on the left side of the chart display (so that the mariner knows where to look for it), bottom justified and about 3mm in from the border of the display. Make sure the symbol is properly sized by your software to represent 1 nautical mile (1852 m) at the scale of the display. For display scales of 1/80,000 or smaller (e.g. 1/250,000) use symbol 'SCALEB11', similarly located, and scaled to represent 10 miles at the scale of the display. For both symbols the display priority is 9, over radar, category display base, viewing group 11030.

Commentaire [J56]: Need to map to the proper maximum display scale value

C9.11.10.2 North arrow:

Use symbol 'NORTHAR1' to indicate true north. Place it in the top left corner of the chart display, inside the scalebar. Rotate the symbol to true north if the display is other than north up, and make sure it is clear of the scalebar even if the latter extends the full height of the display. Display priority is 9; over radar; category display base, viewing group 11040.

C9.11.10.3 Graticule:

If the ECDIS shows a graticule (IMO PS) the lines should be one unit wide, CHBLK.

C9.11.10.4 Display mode:

The ECDIS manufacturer should provide the indication of display mode required in the display base by IMO PS.

C9.11.10.4 Night-time shallow water indicator:

If the entire water area on the display is of less depth than the safety contour, it will not be possible to detect this problem at night due to the small differences between the depth area shades. A faint lattice pattern DIAMOND1 is provided to distinguish shallow water at night (see conditional symbology procedure SEABEDnn). Display priority is 3, suppressed by radar, IMO category is standard and viewing group is 23010. This is not a required feature, but it is recommended that it be made available. The mariner should be given the option of whether they wishe to use the pattern (see section 12.2.18 conditional symbology procedure "SEABED", last question).

C9.11.11 ECDIS Chart 1

<< MAIN 3.1.4 >>

Commentaire [N57]: IEC 61174 ref

ECDIS chart 1,is a graphical index of ECDIS symbols, symbolized lines, and area boundary linestyles used in the display of ENCs. It is intended to familiarize the mariner with the colour and symbol coding used by the ECDIS. The symbols are grouped according to INT1, but are numbered with a look-up sheet. A digital version of ECDIS Chart 1 is part of the ENC test data set; the manufacturer should provide linking by cursor interrogation between the symbols and the explanations given in the symbol library.

Commentaire [J58]: Changed from presentation library – and I don't think it is part of the portrayal catalogue

I think this should be a separate ANNEX

The ECDIS Chart 1 is intended for use off-line and in route planning. It is not needed during route monitoring, when the mariner can use cursor enquiry to find the meaning of symbols.

C9.12 General Colour Assignment for ECDIS Features <<Main 5.2.5 – Tbl 1>>

- **black/white (black by day / white by night)** is used for critical navigation features which need highlighting by contrast against their background to give them adequate prominence.

EXAMPLE: own-ship symbol, dangerous soundings less than the safety depth, buoys, conspicuous features on land etc. It is also used for text, which is less clear in any other colour.

- **white/black (white by day / black by night)** as a background area shade is used for deep, safe, water.

- **magenta** is used to highlight critically important features such as isolated dangers, traffic routes, anchorages; and for restricted areas, submarine cables, gas pipelines etc. It is also used for aids to navigation and services such as daymarks, racons, and pilot stations.

- **grey** is used for many features which are black on the paper chart. It is used with thick lines for critical physical features such as bridges and overhead cables, and with thin lines for important but less critical physical features such as non-dangerous soundings, sandwaves, overfalls, water pipelines and fish farms. It is similarly used for chart features such as fairways, harbour areas, tidal information and for information about the chart such as quality of chart data, overscale areas, etc.

- grey as a background area shade is used with a prominent pattern for no-data areas.

- **blue** as a background area shade is used to distinguish depth zones.

- **blue** as foreground colour for AIS and VTS information; also reserved for future requirements.

- **green** is used for the radar image and synthetics, and for buoy and lights colours.

- **blue-green** is used for transferred ARPA.

- **yellow-green ('moss-green')** as a background area shade is used for the intertidal area between high and low waterlines,

- **yellow** is used as the manufacturer's colour; for the mariner's transparent colour fill; and for buoy and lights colours.

- **red** is used for the important planned route, for the mariner's danger highlight, and for buoy and lights colours.

- **orange** is the mariner's colour, for notes, chartwork, chart corrections. The scale bar, north arrow, and mariner's navigation features such as EBLs and VRMs are also orange.

- **brown** as a background area shade is used for the land, and dark brown is used for features on land and in the intertidal area that do not have any strong significance for navigation.

C.11 Data Product Delivery

C.11.1 Introduction

C.11.2 Exchange Set

The ECDIS must be able to carry multiple versions of the feature catalogue. It is keyed to the version number of the Product Specification and Catalogues. For example, it will need to carry all valid catalogues that are to be used for datasets that have been produced from a different edition of the product specification. Need to clarify that only major catalogue changes need to have multiple catalogues, but minor changes should not have to need a have a replacement catalogue.

Major – what is a major change – Everything needs to be replaced.

Minor – correction which would warrant a new catalogue that sits next to the old one because you can't cater for legacy data.

Very Minor

Scenerios –

New Attribute

New ennumarant

New Feature

Feature changes type.

C.11.3 Dataset

Commentaire [N59]: 2J: Realizing this part of the document is "under construction", suggest that a placeholder be put in for replacing and terminating existing files for both datasets and support files to ensure it is covered in due course.

Add placeholder for replacement of dataset and terminate dataset.
Add placeholder for replacement of support file and terminate support file.

TSMAD24: Agreed

C.11.3.1 Data Sets

NEED WORKED EXAMPLES OF NON OVERLAPPING DATASETS

Placeholder for replacement of dataset

Placeholder for termination of dataset

C.11.3.3 New Editions, Re-Issues and Updates

When a feature pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the ECDIS software should check to see whether any other feature referenced the same file, before that file is deleted.

NOTE FROM TSMAD25: (NO)Currently says that **The issue date must be greater than the previous issue date of the data set**. If this goes for updates as well I would like to allow for the issue date of an update to be the same as the previous update. We sometimes have to make more than one update to a dataset on the same day, this could be just for technical reasons or to fulfil the requirement in clause 4.5.2.1 regarding size on update files.

Did talk about having to have a way for the ECDIS end user to know if there data is up-to-date. Implementation guidance

C.11.4 Support Files

Place holder for replacement of support files

Place holder for termination of support files.

ANNEX D – Feature Catalogue

ANNEX F – Portrayal Catalogue