

**INTERNATIONAL HYDROGRAPHIC ORGANIZATION**



**IHO ELECTRONIC NAVIGATIONAL CHART  
PRODUCT SPECIFICATION**

**Phase 3 – February 2012**

Standard Number 101  
Electronic Navigational Chart Product Specification

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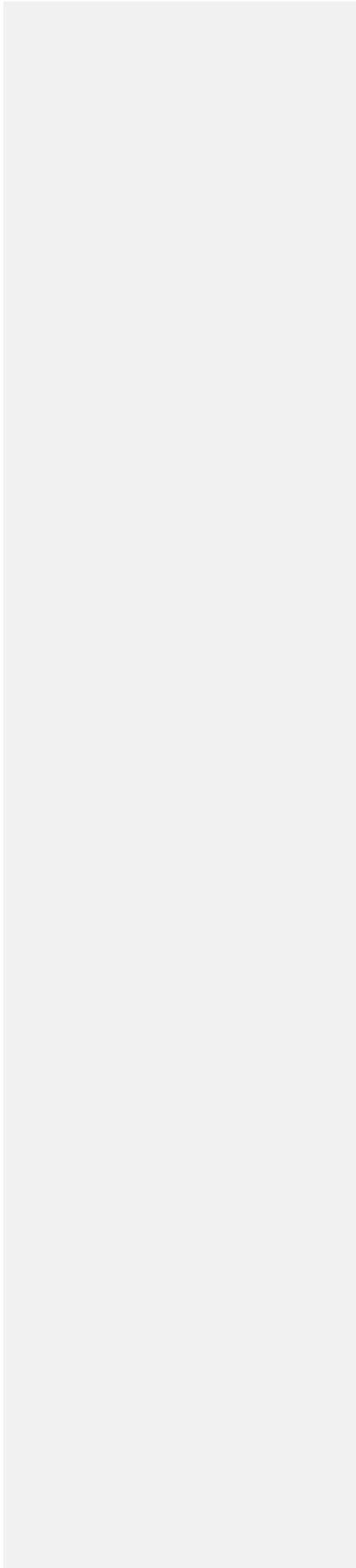
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# 1 Overview

## 1.1 Introduction

S-101 is the Electronic Navigational Chart Product specification, produced by the International Hydrographic Organization. S-101 draws upon the concepts of S-100 such as exchangeable and dynamic feature and portrayal catalogues, and richer geometric models, information types and complex attributes. The use of these new feature types will allow ENC producers to overcome a number of known encoding shortcomings in S-57 based ENCs such as the overuse of caution areas. In addition, the improved functionality will lead to more efficient data handling and better portrayal definition within ECDIS equipment, by eliminating or reducing the number of conditional symbology procedures.

One of the major benefits in S-101 is the ability to introduce additional functionality that is not available in S-57 ENCs. S-101 ENCs will be the base navigation layer within an S-100 enabled ECDIS, and will interact with other S-100 based product specifications such as predicted tides, port operations information and nautical publications.

## 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.

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

### 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 base, 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.

#### ENC dataset

Geographic division of the ENC data for distributing purposes

#### ENC Product Specification

**Comment [N1]:** Need to re-write Introduction

CARIS: Why do we need richer data models ENC?

- 1.To allow encoding of information for better use, reuse and validation.
- 2.To reduce the need for unstructured text in “Inform” attributes and attached text files.
- 3.To improve structure, validation and use of relationships between features and between attributes
- 4.Text placement

What are other areas of improvement over S-

- 1.More efficient and constrained geometry model
  - 2.Improved exchange set structure and related meta data
  - 3.Cell loading strategy included in specification
- Specification designed to allow content , content definition(feature catalogue) and behaviour (presentation catalogues) to be updateable without breaking implementations. This will facilitate the ability to introduce new navigationally significant features.

UKHO: Suggest that this section is reworded to introduce the document and its purpose rather than highlight the benefits of S-101. This could be mentioned briefly in a final paragraph.

**Comment [N2]:** UKHO: Add sentence that only datasets which meet all musts are valid ENCs to make this explicit.

**Formatted:** No bullets or numbering

**Comment [br3]:** I doubt there will be an occurrence of these scenarios in the ENC world. In which case this note is irrelevant. Why don't you combine this definition with the ENC dataset definition.

**Comment [br4]:** An ENC is not a database.

Editor's Note: This is the definition used by the IMO where it says database.

The set of specifications intended to enable the production of a consistent ENC, and manufacturers to use that data efficiently in an ECDIS that satisfies the IMO Performance Standards for ECDIS. An ENC must be produced in accordance with the rules defined in this Specification and must be encoded using the rules described in the Data Capture and Classification Guide.

### 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 function is for use within an Electronic Chart Display and Information Systems (ECDIS) to meet International Maritime Organisation (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.

**Comment [N5]:** UKHO – purpose instead of function

**Content:** This Product Specification is a complete description of all the appropriate features, attributes and their relationships necessary to define an ENC data product. The precise content is documented within the Feature Catalogue and the relationships defined in the Application Schema. Details of how these features should be symbolised are contained in the associated Portrayal Catalogue.

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 Data Classification and Encoding Guide (DCEG) provides the guidance on how the data product content must be captured.

Comment [N6]: UKHO proposed new word for content

### Spatial Extent:

**Description:** Areas specific to marine navigation.

**East Bounding Longitude:** 180

**West Bounding Longitude:** -180

**North Bounding Latitude:** 90

**South Bounding Latitude:** -90

**NOTE:** Datasets may cross the 180 degree longitude line

**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 of vessels between destinations.

Comment [N7]: US: the problem might be building the dataset across the 180 degree line, we seem to be used to cutting the data, why stop now.

JAPAN: Although described as 'Data Sets may cross the 180° meridian.', we think that a dataset must not cross the 180° meridian.

Comment [N8]: US: Add route planning

### 1.5 Data product specification metadata

Note: This information uniquely identifies this Product Specification and provides information about its creation and maintenance.

**Title:** The International Hydrographic Organization Electronic Navigational Chart Product Specification

**S-100 Version:** 1.0.0

**S-101 Version:** 0.2.0

**Date:** February 2011

**Language:** English

**Classification:** Unclassified

**Contact:** International Hydrographic Bureau (IHB)

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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 shall must be made available via the IHO web site. Maintenance of the Product Specification shall 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 shall 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.

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

Changes in a revision are minor and promise 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, and a portrayal catalogues can always rely on earlier versions of the feature catalogues.

### 1.5.1.4 Clarification

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

Changes in a clarification are minor and promise 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 catalogues can always rely on earlier versions of the feature catalogues.

### 1.5.1.5 Version Numbers

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

New Editions denoted as **n**.0.0

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

**Comment [N9]:** 2J: To be able to comply with rules set out under 1.5.1, the FC must contain reference to the version of the FCD items it uses. Without these references the FC becomes a living document, which will break versioning rules for the product specification.

ED NOTE: We need to be explicit that if a new version of the FC or PC is needed it creates a new version of S-101 as a whole

**Comment [N10]:** UKHO: Specialise to this document. Wording is based on S-100 and other standards. Should be made to reflect changes which may occur to this product specification to remove ambiguity.

ED NOTE: no revisions were proposed

**Comment [N11]:** 2J: Currently there are no restrictions on deleting items from a FC or PC during maintenance. This result in a need to obtain and keep all possible catalogues under the same edition of the product specification, unless all producers migrate to the new revision or clarification version simultaneously and all data compliant to older versions is simultaneously terminated (a very unlikely scenario). Suggest adding a restriction to revisions and clarifications that they must be backwards compatible within the same major version. This should enable systems to only keep the latest version of the FC and PC under the same edition of the product specification.

**Comment [N12]:** From 2J

**Formatted:** Space After: 0 pt

**Comment [N13]:** From 2J

**Formatted:** English (U.S.)

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 ~~will be~~ can be identified ~~able~~ by its ~~the~~ discovery metadata ~~that supports it.~~

Comment [N14]: UKHO: Editorial Changes

**Title:** Electronic Navigational Chart

**Alternate Title:** ENC

**Abstract:** S-101 ENC must be produced in accordance with the rules defined in the S-101 Product Specification. S-101 details specifications intended 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

**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 The optimum scales for ENC have been aligned with the standard RADAR ranges and are as follows:

Comment [N15]: UKHO: Proposed wording

Standard RADAR Ranges	Optimum Scale
200 NM	1:3,000,000
96 NM	1:1,500,000
48 NM	1:700,000
24NM	1:350,000
12 NM	1:180,000
6 NM	1:90,000
3 NM	1:45,000
1.5 NM	1:22,000

0.75 NM	1:12,000
0.5 NM	1:8,000
0.25 NM	1:4,000
	<1:4,000

Table 1: Optimum Display Scales

<b>Purpose:</b>	Electronic Navigational Chart for use in Electronic Chart Display and Information Systems
<b>Language:</b>	English (Mandatory), other (Optional)
<b>Classification:</b>	Data can be classified as one of the following:  Unclassified Restricted Confidential Secret Top Secret
<b>Spatial Representation Type:</b>	Vector
<b>Point of Contact:</b>	Producing Agency
<b>Use Limitation:</b>	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 Feature Catalogue provides a full description of each feature type including its attributes, attribute values and relationships in the data product.

### 4.2 Application Schema

S-101 uses 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 Application Schema is a realization of the feature catalogue and the UML depicted in this section are selected 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.

**Comment [N16]:** UKHO: Needs rewording reflect that the S-101 application schema is realised in the feature catalogue and the product specification only contains examples from it. Suggest reword, also should say conforms to the S-100 GFM not 'uses'.

## 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

Skin of the Earth features are a set of geo features of geometric type area that must not overlap each other and form a continuous surface named "Skin of the Earth". [The Skin of the Earth Feature Types are listed below:](#)

**DepthArea**

**DredgedArea**

**LandArea**

**UnsurveyedArea**

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). 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.

The maximum use must be made of meta features to reduce meta attribution on individual features.

The Meta feature **DataCoverage** provides an exhaustive, non-overlapping coverage of the entire dataset.

#### 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 Aggregation 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.

Comment [N17]: UKHO

Comment [N18]: UKHO: Could now have more than one data coverage wording needs reflect this.

ED NOTE: We could just delete this paragraph as we talk about datacoverage elsewhere

Comment [N19]: 2J: For items where the product specification (PS) and FC are not harmonized (for whatever reason), a note should be added in the PS to explain that one is ahead of the other, and maybe a small comment of why.

UKHO: Propose amend to object relationship explain that feature and information types may be related etc etc

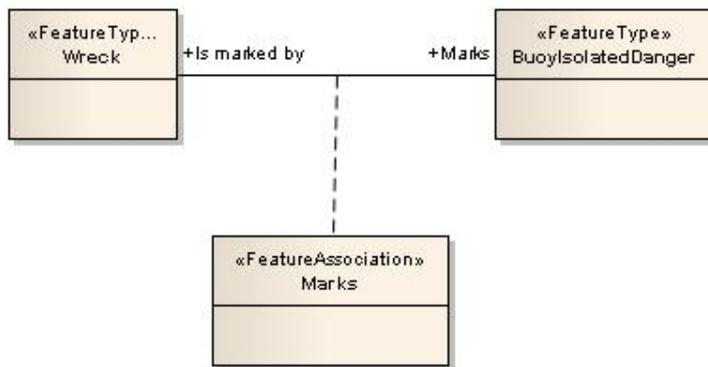


Figure 1 - Association

#### 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**

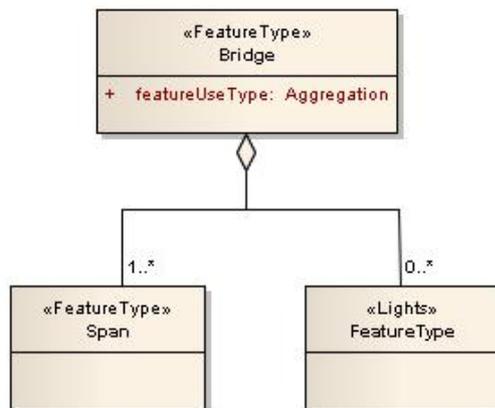


Figure 2 - Aggregation

#### 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.

Comment [N20]: FR: Add the statement :  
Meta attribution on individual feature override  
attribution on meta features.

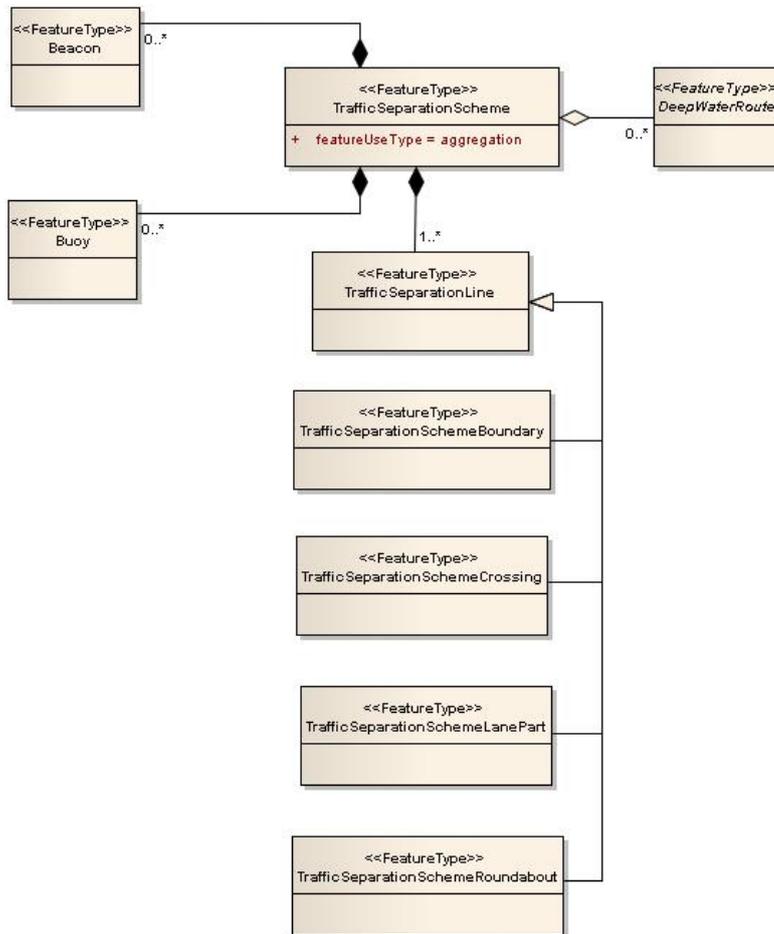


Figure 3 - Composition

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.

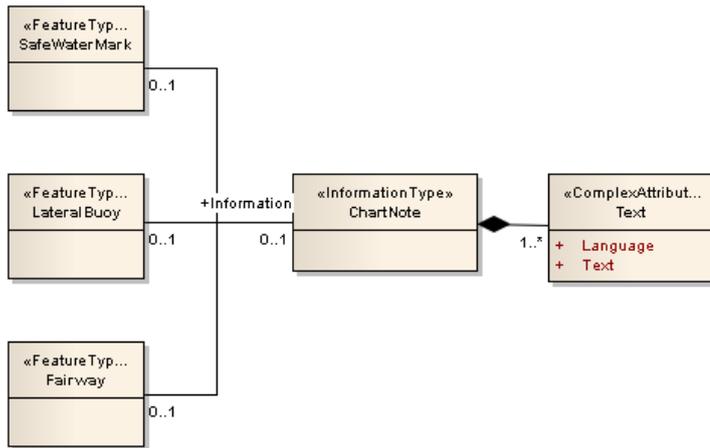


Figure 4 - Information Type

Comment [N21]: UKHO: Figure 4 suggest better example is used. Such as a note regarding safe clearances which is referenced to multiple overhead cable features.

4.3.5 Attributes

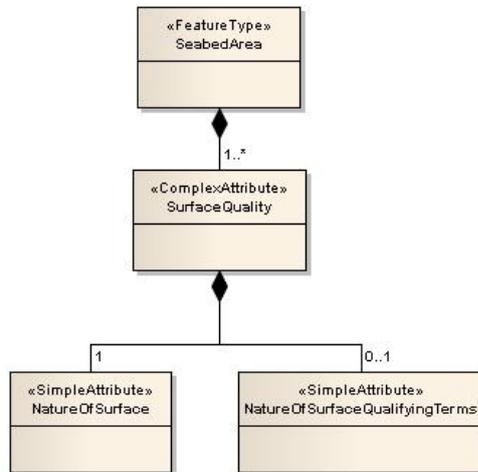
Comment [N22]: UKHO: Should we list the attribute value types here? Suggest these are pretty fundamental. Or refer to the DCEG

4.3.5.1 Numeric Attribute Values

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

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**

**Comment [N23]:** UKHO: Suggest the new complex attribute for topmark would be a better example.

**4.3.5.3 Text Attribute Values**

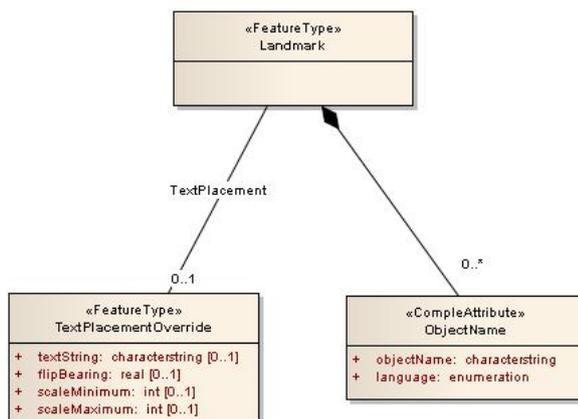
Character strings must be encoded using the character set defined in ISO 10646-1, in Unicode Transformation Format-8 (UTF-8). A BOM (byte order mark) must not be used.

**Comment [N24]:** JP: It should be described that the BOM (Byte Order Mark) must not be used. Because the character strings must be used UTF-8 in S-101 and it is described by Unicode Standard, Ver. 6.0 (Chapter 2.6 Encoding Schemes Page.30) as follows. 'Use of a BOM is neither required nor recommended for UTF-8.' Reference The Unicode Standard, Ver. 6.0 (URL: <http://www.unicode.org/versions/Unicode6.0.0>)

**4.3.5.3.1 Text Placement**

In order to improve ENC display in ECDIS S-101 includes a Text Placement Override feature. This defines a position using its (point only) geometry about which the text string must display. This feature is associated to a feature with a text attribute which is then positioned accordingly. In addition to its position the Text Placement Override feature enables setting of scale minimum and scale maximum to declutter text independently of a feature. Also it provides a text string attribute which can override the encoded text attribute and supports a flip bearing which determines which side of the position the text will rotate through.

**Comment [N25]:** Lots of Comments. Would suggest a small break out to work on these.



**Figure 6 - Text Placement**

#### 4.3.5.4 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 [B-A](#) – Data Classification and Encoding Guide.

#### 4.3.5.5 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.

### 4.4 Feature Object Identifier

Each real world feature and instances of information type 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.

For ENC the Feature Object Identifier may be used to identify multiple instances of the same real world feature within a single [cell/dataset](#) or across multiple [cell/datasets](#). For example, the same feature may appear in different optimum display scales, or a feature may be split by the [cell/dataset](#) structure. In these circumstances each instance of this feature should have the same identifier.

Feature Object Identifier's must not be reused, even when a feature has been deleted.

### 4.5 Dataset Structure

#### 4.5.1 Introduction

Datasets may be structured in several ways. They can be a complete dataset, where all ENC features must be contained within the dataset, or as a combination of scale independent and scale dependent data. Unless it is specifically noted all specifications within this product specification apply to scale independent and dependent datasets

#### 4.5.2 Complete Datasets

A complete data set contains all the appropriate ENC features needed for navigation within one dataset.

#### 4.5.3 Scale Independent and Scale Dependent Datasets

ENC producers may partition a set of navigational data into two separate datasets based on the scale dependent and scale independent geometric properties of features. This concept splits a collection of data into two datasets. One dataset holds a set of scale independent features such as Aids to Navigation and the other dataset holds scale dependent data which may be the subject of

**Comment [N26]:** UK: The DCEG introduction covers these items, Suggest that contents needs to be aligned.

FURUNO: This clause specifies that all mandatory attributes are identified in the Feature catalogue and summarized in Annex – data classification and Encoding Guide

The reviewer is confused as the Annex B of the document is for another topic: "Data product format".

Anyhow as the S-101 will be based on machine readable principle, then there must be somewhere machine readable data which contain information which attributes are mandatory or alternative (in S-57 alternative means that one of the alternative attributes is mandatory). The basic S-100 do not contain such information as in general the products derived from the S-100 are not required to share equal rules of allowed, alternative and mandatory attributes for each object.

FURUNO: There is a need for machine readable data to define for each object allowed for the S-101 which attributes are a) mandatory b) alternatively mandatory and c) allowed

ED Note: Fixed the reference. The bigger question is do we want a list of Mandatory Attribute Values in the main part of the PS or are we content with them being in the DCEG encoders and identified in the Machine Readable FC for implementers

**Comment [N27]:** CARIS: "For ENC the Feature Object Identifier may be used to identify multiple instances of the same real world feature within a single cell or across multiple cells."

I believe that we intended to allow a single feature to reference multiple disjoint spatial features in the SPAS field which should mean that a feature cut by the dataset limit would only need to have one instance within the dataset. In other words we should not need to allow duplicate FOIDs in a dataset.

**Comment [N28]:** CARIS: If a feature is deleted from a dataset can the same feature be restored, using the same FOID. What if a buoy is moved and new position is outside of the dataset and then is moved back again. One update would have to delete the buoy and another add it back with the same FOID.

Clarify that a FOID may not be reused by another feature even when the other feature has been deleted

**Comment [N29]:** UKHO: Dataset structure do we mean this or do we mean how datasets interact through the scales? 'The can be'?

Clarify Wording

generalization such as coastline features. Scale independent and scale dependent datasets must form both a vertically and horizontally complete coverage in order to be fit for navigation. The business rules for of scale independent and scale dependent datasets are located in Annex C.

#### 4.5.4 Scale Independent Dataset

Scale Independent (SI) datasets may have different geographical extents than the scale dependent dataset and must only contain the allowable features listed in clause 4.5.4.1. The following specifications apply to SI datasets:

- Must only have one dataCoverage and must not overlap each other.
- maximumDisplayScale must be 1:3,000,000
- minimumDisplayScale must be 1:4,000
- SCAMAX and SCAMIN may be applied to features within the dataset
- A feature that is in a SI dataset may not be repeated in the Scale Dependent dataset

##### 4.5.4.1 Scale Independent Dataset Content

Listed in Table 2 are the allowable features and their geometric primitive types which make up the content of a scale independent dataset. P,L,A refers to point, line and area.

ACROYNM	NAMES	GEOMETRIC TYPE	UKHO FODB	NOAA Scale Independent Features
BCNCAR	Beacon, cardinal	P	P	P
BCNISD	Beacon, isolated danger	P	P	P
BCNLAT	Beacon, lateral	P	P	P
BCNSAW	Beacon, safe water	P	P	P
BCNSPP	Beacon, special purpose/general	P	P	P
BUISGL	Building single	P, A	P	
BOYCAR	Buoy, cardinal	P	P	P
BOYISD	Buoy, isolated danger	P	P	P
BOYLAT	Buoy, lateral	P	P	P
BOYSAW	Buoy, safe water	P	P	P
BOYSPP	Buoy, special purpose	P	P	P
BOYINB	Buoy, installation	P	P	P
CGUSTA	Coastguard station	P	P	
CHKPNT	Check point	P		
CTRPNT	Control Point	P		

**Comment [N30]:** CARIS: Why restrict min/max scale. Why not just allow the dataset to cover a range of scales that spans multiple base datasets. Could it be desirable to have example 2 Si datasets, one that works with large-medium scale base data and one for small scale datasets?

Seems that really the scale dependent and scale independent are just variations on range of applicable scales. It might be better to identify the datasets as complete or incomplete in the sense of useable for navigation. Then define how the dependencies will be managed to allow an ECDIS to combine datasets to acquire a complete set usable for navigation. Perhaps individual datasets be marked not for navigation or use for navigation only if combined with dataset X.

**Comment [N31]:** TO DO: This table needs to be reviewed and a common set of SI features need to be agreed to by TSMAD.

**Comment [N32]:** CARIS: If we are fixing what can go in what dataset then perhaps give it a proper name. Base dataset + Navinfo dataset Can be combined in one dataset or delivered as separate combinable and updateable dataset

DAYMAR	Day mark	P	P	P
DISMAR	Distance mark	P		
FOGSIG	Fog signal	P	P	P
DWRTCL	Deep water route centreline	L		
DWRTPT	Deep water route part	A		
FORSTC	Fortified structure	P	P	
LNDMRK	Landmark	P	P	
LIGHTS	Light	P	P	P
LITFLT	Light Float	P	P	P
LITVES	Light vessel	P	P	P
MORFAC	Mooring/Warping facility	P	P	
PILPNT	Pile	P		
PILBOP	Pilot boarding place	P		
OBSTRN	Obstruction	P		
OFSPLF	Offshore platform	P	P	
OSPARE	Offshore production area	A		
PILBOP	Pilot boarding place	P, A		
PRCARE	Precautionary area	P, A		
PYLONS	Pylon/bridge support	P	P	
RADRFL	Radar reflector	P		P
RADSTA	Radar station	P	P	P
RTPBCN	Radar transponder beacon	P	P	P
RDOCAL	Radio calling-in point	P	P	
RDOSTA	Radio station	P	P	P
RECTRC	Recommended track	L		
RSCSTA	Rescue station	P	P	
SISTAT	Signal station, traffic	P	P	

SISTAW	Signal station, warning	P	P	
SILTANK	Silo/tank	P	P	
TOPMAR	Top mark	P	P	P
TSELNE	Traffic separation line	L		
TSEZNE	Traffic separation zone	A		
TSSBND	Traffic separation scheme boundary	L		
TSSCRS	Traffic separation scheme crossing	A		
TSSLPT	Traffic separation scheme lane part	A		
TSSRON	Traffic separation scheme roundabout	A		
TWRTPT	Two-way route part	A		
UWTROC	Underwater/awash rock	P		
WRECKS	Wreck	P, A		

#### 4.5.5 Scale Dependent Datasets

Scale dependent datasets will not contain any of the feature classes present in the scale independent list. Scale dependent datasets with the same [maximum display scale](#) may overlap. However, data bounded by the DataCoverage feature must not overlap. Therefore, in the area of overlap only one dataset may contain data.

Comment [N33]: FR: Add Maximum

#### 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 Minimum Display Scale (MINDSC) and the largest scale by the Maximum Display Scale (MAXDSC). 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** areas features contained within that dataset and its assigned MINDSC and MAXDSC. **DataCoverage** area features within a data set must not overlap.

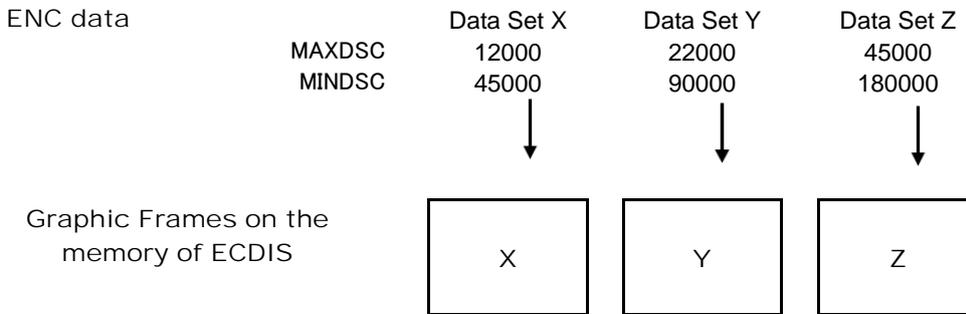
##### 4.6.1 Dataset Loading and Unloading

~~The ENC in the ECDIS consists of a mosaic of different datasets. The geographic coverage is not always complete throughout the viewing spectra, ENC's form a seamless coverage in ECDIS which covers different areas with different scales of data.~~ e.g. scale dependent ENCs suitable for the large scale viewing interval may only exist for ports.

Comment [N34]: UKHO: Reword 'mosaic a spectra', complex words unclear to those for which English is not a first language. Recommend ENCs form a seamless coverage in ECDIS which covers different areas with different scales of data.

**4.6.1.1 Algorithm for dataset loading and unloading**

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



\*Graphic frames are created 50-60 times per second according to Mariners Selected Viewing Scale (MSVS).

**Comment [N35]:** TRANSAS: Purpose of ordering of DataCoverage objects by percentage of coverage is not well described. According to the algorithm, chart engine should analyze several DataCoverage and associate other chart objects with certain DataCoverage

It will be more effective to assign Minimum and Maximum Display Scale values to each of the chart objects within the dataset

BSH: The value for MINDSC should be a rounded scale value -1. It should be handled similarly to SCAMIN. For the system it must be evidently clear if a dataset should be loaded or not or shown with overscale pattern at a specific display scale.

Other paragraphs explaining cell loading and unloading philosophy must be changed accordingly

Condition		Combining Graphic Frames	
1	$MSVS = 45000$ $MAXDSC(X,Y,Z) \leq MSVS \leq MINDSC(X,Y,Z)$	X	+ Y + Z
2	$MSVS = 90000$ $MAXDSC(Y,Z) \leq MSVS < MINDSC(X)$		+ Y + Z
3	$MSVS = 22000$ $MAXDSC(X,Y) \leq MSVS < MAXDSC(Z)$	X	+ Y + Z + Overscale indication of Z

\* Graphic frame of smaller MAXDSC is drawn first.

**Figure 7 - Data Loading and Unloading Algorithm**

**Comment [N36]:** TRANSAS: Does it mean that ECDIS display should be redrawn with 60 Hz frequency? If this is the case, it will overload ECDIS chart engine and actually such frequency is not required for navigation. 1 Hz or one redraw per second is enough.

CARIS: This bit about graphic frames "Graphic frames are created 50-60 times per second according to Mariners Selected Viewing Scale (MSVS)." Seems rather implementation specific. Is it needed to describe the concept of combining various scales of data in a defined draw order?

Replace "Graphic Frames" with "dataset drawing order" or "graphic planes"

**Comment [N37]:**

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

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

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

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.

## 4.7 Geometry

### 4.7.1 S-100 Level 3a Geometry

The underlying geometry of an ENC is constrained to S-100 level 3a which supports 0, 1 and 2 dimensional objects (points, curves and surfaces).

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.
- A curve must not be self tangent
- 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 ~~should~~ must not be encoded at a point density greater than 0.3mm at optimum 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.

Comment [N38]: BSH: What is meant by .3 think 3mm point distance is a bit much or is it 0.3?

FR: Amend "must" for "should" in the sentence "Linear features **should** not be encoded at a point density greater than .3mm at optimum display scale".

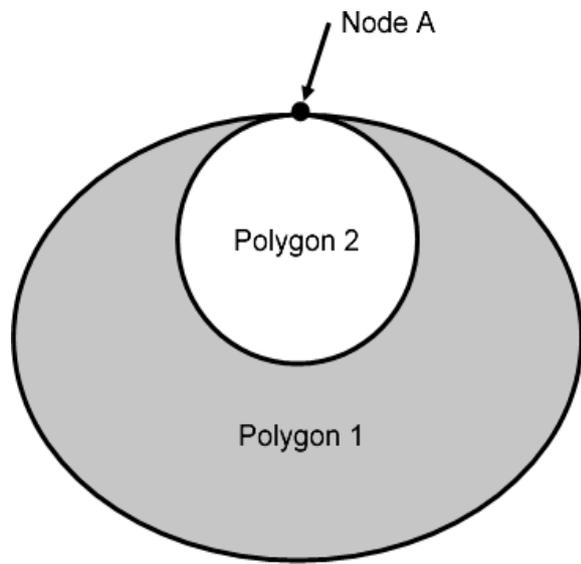


Figure 8 - Self Intersect Example

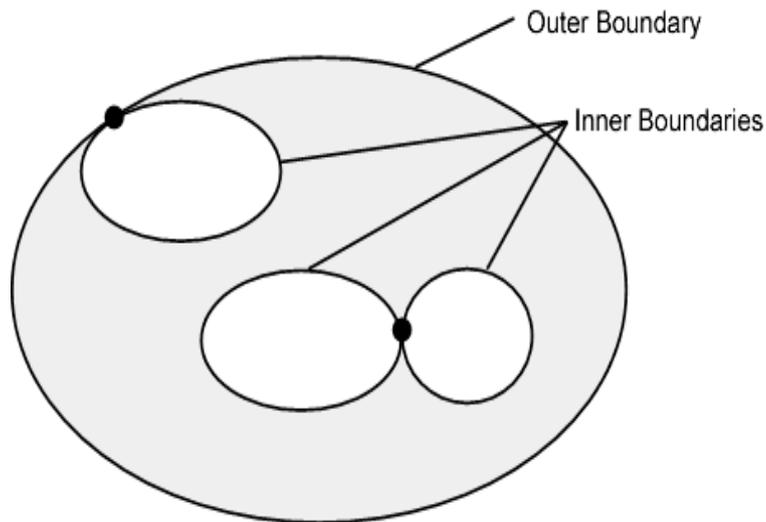


Figure 9 - Area Holes

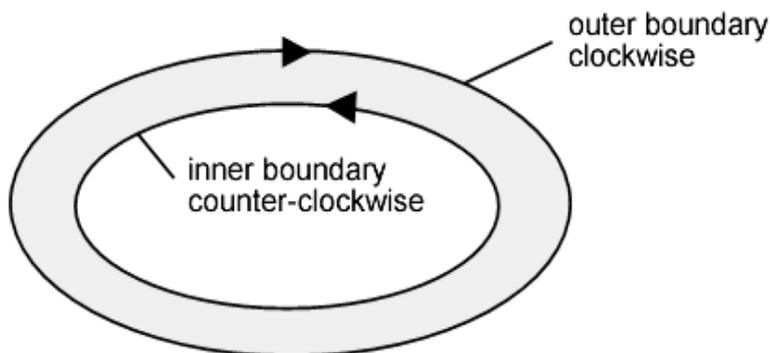


Figure 10 - Boundary Direction

#### 4.7.2 Masking

The presentation of symbolised lines may be affected by line length. 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.

**Comment [N39]:** TRANSAS: Masking has nothing to do with length of symbolized line.

Remove the first sentence from the paragraph

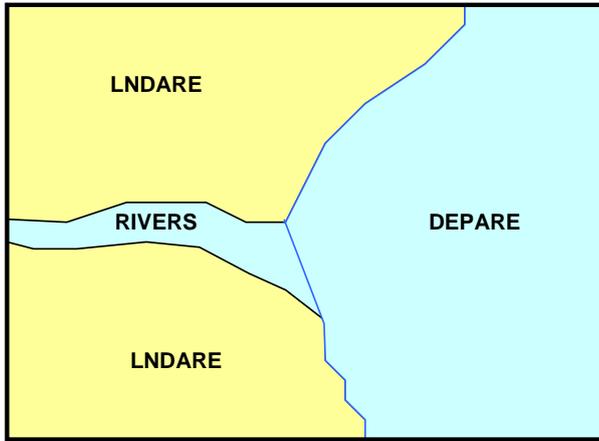


Figure 11 - Example without Masking

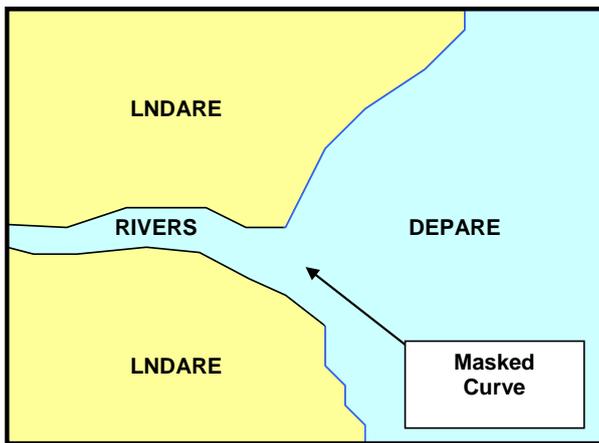


Figure 12 - Example of masked edge between Rivers and DEPARE features

## 5 Coordinate Reference Systems (CRS)

### 5.1 Introduction

Due to the nature of hydrography 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 a 2D geodetic CRS (WGS84) and a vertical CRS.

Comment [N40]: UKHO: We state units are metres but this is not defined within the 8211 encoding.

Propose add attributes to the dataset attribute to carry units.

## 5.2 Horizontal Coordinate Reference System

For ENC the geodetic datum of the horizontal CRS must be EPSG:4326 (WGS84). No projection is to be used. The full reference to EPSG:4326 can be found at [www.epsg-registry.org](http://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).

# 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 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.

### 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.

Data quality is broken into three main meta features; **QualityOfBathymetricData**, **QualityOfNonbathymetricData** and **QualityOfSurvey**. This is necessary to properly express data quality for bathymetry items as opposed to non-bathymetry items. 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).

Figure 11 shows the high level architecture for the revised data quality representation system used in S-101. The individual data quality indicators (meta features and attributes) that are encoded in the ENC provide individual inputs into the data quality algorithm, which resides within the ECDIS system.

**Comment [N41]:** UKHO: Should we specify the minimum accuracy to which something should be referenced to WGS-84? We do not state how accurately data is referred to WGS-84.

Add clause to cover minimum accuracy to WGS-84. Refer to DQWG?

**Comment [N42]:** TRANSAS:

1. Is vertical datum supposed always be the same as sounding datum, i.e. will the same vertical CRS be used for depths and heights on land?
2. Different vertical datums are allowed for the dataset. This will cause difficulties for constructing bottom model and applying water level values.
3. Vertical datum should also be applied to depth contours, isolated dangers

Add requirement to use the same vertical datum at least for overlapped datasets covering the same geographical area.

Look into a possibility to use corrective values to assign depth data obtained from various datasets with different vertical datums.

**Comment [N43]:** UKHO: Do not consider it sufficient to solely refer to S-58 here. Data quality is a much larger concept which S-58 only addresses certain elements of.

Propose reword to reflect ISO 19157 (draft).

ED NOTE: This was done as to reflect what S-100 in the product specification stated should be for data quality – that there needed to be a set of checks.

This algorithm has the capability to accept additional optional inputs from vessel specific parameters (entered into the ECDIS) and external information (e.g. Dynamic tides). This algorithm then drives an on-demand data quality overlay that exists within the ECDIS system.

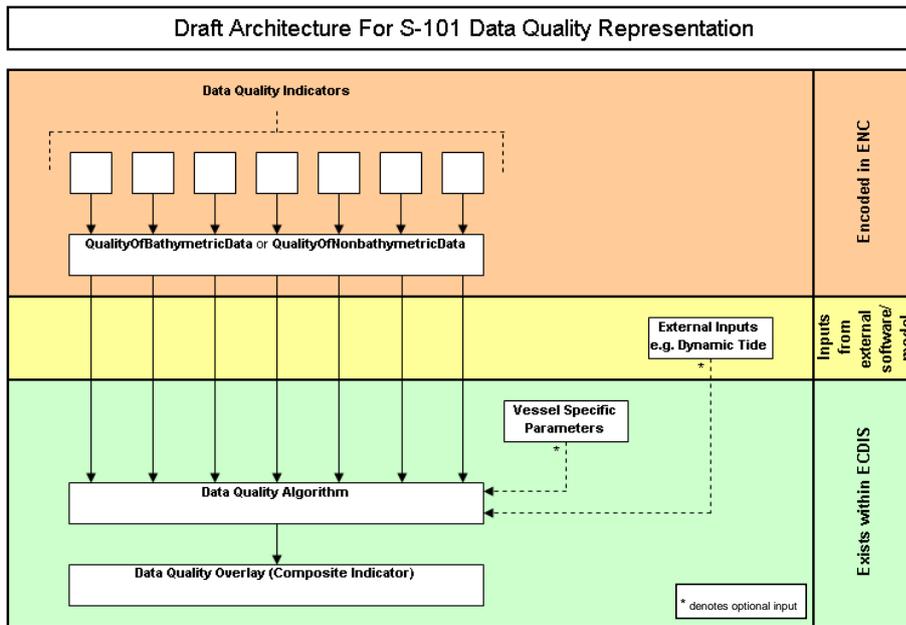


Figure 43-11 - Bathymetric Data Quality

The encoding of bathymetric data is located in S-101 ENC Data Classification and Encoding Guide and the portrayal of data quality information is located in the S-101 Portrayal Catalogue

## 7 Data Capture and Classification

### 7.1 Introduction

The S-101 ENC Data Classification and Encoding Guide (DCEG) provides the information to map real world features into the dataset. This Guide is located in Annex A. S-101 datasets should conform to the ENC DCEG.

Comment [N44]: UKHO: change to should

## 8 Maintenance

Maintenance and Update Frequency:

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

#### 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. The data source is stored internally in the producing agencies production system.

#### Production Process:

Data Producers should follow their established production processes for maintaining and updating datasets. ~~Datasets shall must be checked against S-58 (equivalent).~~ Data is produced against the DCEG, checked against S-58 and encapsulated in ISO/IEC 8211.

## 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: THIS SECTION TO BE FILLED OUT BY MAY. 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 as an normative annex and business rules).

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.

## 10 Data Product format (encoding)

### 10.1 Introduction

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

**Comment [N45]:** UKHO: Notices to mariner should not refer to notice to mariners. Could expand to say that ENCs should include T/P information?

Propose use ENC Updates rather than Notices to mariners.

NO: ENC updating mechanisms must include both Notice to Mariners and New Editions. For the NtM is a mechanism for updating the Paper Charts.

We produce several ERs not published in the NtM, where the level of detail makes them not applicable for correcting the paper chart. A NtM for the Paper Chart may also trigger a new edition in the ENC for technical reasons.

Remove link to paper chart world by not assuming NtM=ER?  
I also realize that this sentence may be interpreted that mechanisms for caretaking at least NtMs and New Editions must be present so maybe just some rewriting or clarification?

ED NOTE: Should we just use what SOLAS says regarding up to date...

**Comment [N46]:** FR: redundant wording

**Comment [N47]:** UKHO: Should reference 100 here and not repeat the structure. Only items which are specific to S-101 should need repeating.

ED NOTE: Discuss as we usually incorporate what we need from S-100 and not refer back to it.

**Format Name:** ISO/IEC 8211  
**Version:** 1.0.0  
**Character Set:** ISO 10646 Base Multilingual Plane  
**Specification:** S-100 profile of ISO/IEC 8211 (part 10A)

**Comment [N48]:** FURUNO: The machine readability of the s-100 object catalogue, S-101 attribute catalogue, S-101 product catalogue (this defines allowed, mandatory etc. for objects and attributes), S-101 presentation catalogue etc. require that the ECDIS software is able to perform version control between all machine readable catalogues and END data files. The version control is required to detect possible mismatch, in case of downward everything is ok (downward compatibility) but in case of upward it will be unknown how to operate correctly. In the upward situation the ECDIS is assumed to request the end user to update the machine readable catalogues to be compatible with every ENC loaded into the ECDIS.

Simplest way to support version control is that the DSID field of the ENC chart will contain the version number for which that ENC chart has been produced. Version number of S-101 is defined in the clause 1.5.1.5. The 3 integer numbers of the version should be added into the DSID field.

**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.

These coordinate multiplication factors must be set to 10000000 (10<sup>7</sup>) for all datasets.

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

**10.1.2 Encoding of Depths (S-57 PS 4.4)**

Depths are converted from decimal metres to integers by means of the CMFZ. This product limits the resolution to two decimal places and therefore the CMFZ must be set to 100.

**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.

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**Figure 13 - Exchange Set Structure**

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## 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.

<b>Units of Delivery:</b>	Exchange Set
<b>Transfer Size:</b>	Unlimited
<b>Medium Name:</b>	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](#).

- [TXTDSC](#)
- [NXTXDS](#)
- [PICREP](#)

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.

Data conforming to S-101 ~~shall~~[must](#) be transformed, but not changed.

This product specification defines the encoding which must 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. Defined further in Annex ??.
- Exchange Catalogue – the XML encoded representation of exchange set catalogue features [discovery metadata]. 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.

**Comment [N49]:** UKHO: Support file attributes need updating

2J: Reference to NXTXDS is made obsolete new model of text attributes – the "N" attribute won't be needed delete NXTXDS, and change alpha codes to name.

**Comment [N50]:** NO: Feature and portrayal catalogues listed as optional elements in the exchange set while datasets are mandatory elements. This means it is not possible to distribute a feature or portrayal catalogue update without including at least one dataset? In most cases there will be a dataset triggering the updates of the feature or portrayal catalogues, but will there be a need of distributing only a feature catalogue or portrayal catalogue update without any dataset?

Probably not an issue... Guess in most cases the FC/PC updates will be attached to the normal dataset distribution anyway.

## 11.3 Dataset

### 11.3.1 Datasets

Three types of ENC dataset may be produced and contained within an exchange set:

- Update: Changing some information in an existing data set.
- re-issue of a data set : 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.
- 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

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**.

Features with the geometric properties of point or line coincident with the border of two data sets with the same maximum display scale must be part of only one data set.

When a feature extends across data sets at the same maximum display scale its geometry must be split at the data set boundaries and its complete attribute description must be repeated in each data set.

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 should be done by issuing a new edition of the dataset.

Data Sets may cross the 180° meridian.

#### 11.3.1.1 Dataset size

Datasets ~~shall~~ must not exceed 10MB.

Updates ~~should~~ ~~shall~~ not exceed 50kb.

#### 11.3.1.2 Complete Datasets

Data Sets (limits defined by the minimum bounding box) 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 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.

#### 11.3.1.3 Scale Independent datasets

Scale Independent datasets must not overlap with other Scale Independent datasets. Scale Independent datasets must not overlap datasets that are identified as a complete dataset.

**Comment [N51]:** CARIS: "Features with the geometric properties of point or line coincident with the border of two data sets with the same maximum display scale must be part of only one data set" This should be allowed if same FOID is used so system knows it is the same object

Features with the geometric properties of point or line coincident with the border of two data sets with the same maximum display scale must be part of only one data set unless the same FOID is used for all occurrences.

**Comment [N52]:** CARIS: "When a feature extends across data sets at the same maximum display scale its geometry must be split at the data set boundaries and its complete attribute description must be repeated in each data set. Surely this only applies to data from same producer and when same FOID is used.

When a feature from a specific origin extends across data sets at the same maximum display scale its geometry must be split at the data set boundaries and its complete attribute description must be repeated in each data set. Ideally the same FOID is used to indicate each piece is part of a larger entity.

**Comment [N53]:** May change dependent upon earlier discussion

US: Change to: Data Sets must not cross the 180° meridian, this includes both the **DataCoverage** and **boundingBox** features.

**CARIS:** If we allow datasets crossing 180 we have to be thorough about definition of bounding rectangles etc to make sure they are lower left, upper right instead of min/max.

**Comment [N54]:** US: 10MB may be too big. Not so much for download and transfer but a GIS and an inspector at this current time will choke on an ENC 10MB ENC.

Change to 7.5MB

**Comment [N55]:** UKHO: Updates 50kb limit. Suggest this is limiting for some updates. Currently a recommendation. Propose "updates should not normally be larger than 50kb and must not be larger than 200kb".

JP: Why is capacity of updates 50kb ? The capacity of updates was defined for some legacy ECDIS that cannot load the big ER in S-57. However, S-101 is a new ENC standard, therefore there is no Legacy ECDIS in the way. If the capacity of updates will be described, it should be described that the capacity of updates should be considered for user convenience.

**Comment [N56]:** FR: What about gap when it is difficult to achieve a perfect join ? Propose to add a statement:

**Comment [N57]:** CARIS: Re overlap of SI datasets: This could be difficult. Perhaps if base datasets have explicit references to overlays won't be a problem if overlays are not drawn except where they overlap the associated base

More thought is needed

#### 11.3.1.4 Scale Dependent Datasets

Data Sets (limits defined by the minimum bounding box) 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 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.

**Comment [N58]:** US: Is the 5 metre overlapping buffer zone a real world distance?

Change: a 5 metre overlapping buffer zone (ground units) may be used.

Ed NOTE: do we want to repeat the FR comment from above

#### 11.3.2 Dataset file naming

##### ENC Dataset files

ENC dataset files are named according to the specifications given below:

CCXXXXXXXXX.EEE

The main part forms an identifier where:

- 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 use 000, updates start at 001 and increment until a limit of 999.

**Comment [N59]:** CARIS: Naming convention of incomplete datasets?

Idea: Introduce concept of a virtual dataset that offers the equivalent of a full dataset for the purpose of cell loading etc but only references the component datasets needed to load it. The virtual dataset would refer to the base + nav info or overlay and when drawn the SI data would be clipped to the cover of the base data. They give incomplete datasets a different naming convention so that they can be ignored for the purpose of cell loading etc. Virtual datasets would be prepared for each scale but could reuse a shared base or SI data.

**Comment [N60]:** TO DO: Do we need to have an SI/SD naming convention.

BSH: Wouldn't it be of an advantage, if there was a common rule for naming scale independent datasets? In this case they could easily be identified by everyone. Even though it is not technically necessary.

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 and Updates

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:

<b>edition number</b>	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.
<b>update number</b>	update number 0 is assigned to a new data set. The first update <code>ee#dataset</code> 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. The new edition must have update number 0.
<b>Re-issue number</b>	A re-issue of a data set must have the update number of the last update applied to the dataset. In the case of an update dataset the file extension is the same as the update number.
<b>update comment</b>	comment for describing the change introduced by an update.
<b>issue date</b>	date up to which the data producer has incorporated all applicable changes.

**Comment [N61]:** US: The statement "the third to tenth characters are optional and may be used in any way by the producer to provide the unique file name." Seems to give the impression that 10 characters are not mandatory or more than the issuing agency characters are needed.

**Comment [N62]:** CARIS: "In the case of an update dataset the file extension is the same as the update number". Is this really what we want? This is different than S-57 and could be confusing. Currently it is clear that a 000 file is self contained but may be a re-issue whereas a 00n file is only an update and must be applied to a base file

Do it the same as in S-57. Re-issue has 000 extension.

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

**Comment [N63]:** UKHO: Need to cover cancellation updates with a business rule.

Propose to add a business rule stating that upon cancellation of a dataset it must be deleted from the system.

An exchange set may contain base [eetdataset](#) files and update [eetdataset](#) files for the same [eetdataset](#)s. Under these circumstances the update [eetdataset](#) files must follow on in the correct sequential order from the last update applied to the base [eetdataset](#) 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)*

File Types	Extensions	
Text	TXT	
	HTM	
	XML	
Picture	TIFF	Baseline TIFF 6.0

### 11.4.1 Support File Naming

All support files will have unique world-wide 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:

CCXXXXXXXXX.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.

### 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 12.3.1 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 should 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.

**Comment [N64]:** CARIS: If we expect systems to do anything with an XML file then more info (schema etc will be needed) There are different flavours of html. Do we expect things like CSS to be supported?

Ask system vendors for agreed specs

UKHO: Need to be specific about the flavour of HTML/L. Suggest XML files are only used for a specific purpose.

## 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.

An example of coding in C language is given in Annex.

Comment [N65]: UKHO: Is coding in C required?

## 12 Metadata

### 12.1 Introduction

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

#### 12.1.1 Exchange Set Metadata

Name	Multiplicity	Value	Type	Remarks
S100_ExchangeSet	-		-	Aggregation of the elements comprising an exchange set for the transfer of data.
aggregateFile	0..*		-	Collection of support files in the exchange set
partOf	0..*		-	Collection of datasets which are part of the exchange set
aggregateCatalogue	0..*		-	Collection of catalogues
superset				The master container exchange set which can contain a subSet of exchange sets
subset				Exchange set which is part of the superSet

**Comment [N66]:** UKHO: Do we need an XSD schema for a catalogue file?

**Comment [N67]:** UKHO: National language support? Should we say may be repeated in a national language?

**Comment [N68]:** UKHO: Supersets? Etc ? requires clarification.

Ed note: This is from S-100

### 12.1.2 Dataset Metadata

Name	Multiplicity	Value	Type	Remarks
S101_DataSetDiscoveryMetadata	-		-	-
metadataFileIdentifier	1		CharacterString	
metadataPointOfContact	1		CI_ResponsibleParty	
metadataDateStamp	1		Date	
metadataLanguage	1	English	CharacterString	All data sets conforming to S-101 PS must use English language
fileName	1		CharacterString	Dataset file name
filePath	1		CharacterString	Full path from the exchange set root directory
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
classification	1	{1} to {5}	Class MD_SecurityConstraints>MD_ClassificationCode (codelist)	1. unclassified 2. restricted 3. confidential 4. secret 5. top secret

**Comment [N69]:** TRANSAS: What is the purpose to have character string instead of integer data types for the following meta data? Purpose, update number, HorizontalDatumReference, laierID

**Comment [N70]:** Should metadata file name be fixed to a common convention?

**Comment [N71]:** UKHO: Should protection scheme be an enumeration?

Name	Multiplicity	Value	Type	Remarks
purpose	1	{1} to {5}	CharacterString  MD_Identification>purpose (character string)	1. New Dataset 2. New Edition 3. Update 4. Re-issue 5. <a href="#">Cancel dataset</a> ation
specificUsage	1	{1} to {3}	CharacterString  MD_USAGE>specificUsage (character string)  MD_USAGE>userContactInfo (CI_ResponsibleParty)	1. Port Entry – A dataset containing data required: <ul style="list-style-type: none"> <li>For navigating the approaches to ports</li> <li>for navigating within ports, harbours, bays, rivers and canals, for anchorages</li> <li>as an aid to berthing</li> </ul> or any combination of the above.  2. Transit – A dataset containing data required for : <ul style="list-style-type: none"> <li>navigating along the coastline either inshore or offshore</li> <li>navigating oceans, approaching coasts</li> <li>route planning</li> </ul> or any combination of the above.  3. Overview – A dataset containing data required: <ul style="list-style-type: none"> <li>for Ocean Crossing</li> <li>route planning</li> </ul>
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 <a href="#">ee#dataset</a> files (i.e. new data sets, re-issue and new edition), not update <a href="#">ee#dataset</a> files. All updates dated on or before this

Name	Multiplicity	Value	Type	Remarks
				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 0.0.1	S-100_ ProductSpecification	This must be encoded as S-101
producingAgency	1		CI_ResponsibleParty	Agency responsible for producing the data.
optimumDisplayScale	1	{1} to {13}	Integer	1: <4,000 2: 4,000 3: 8,000 4: 12,000 5: 22,000 6: 45,000 7: 90,000 8: 180,000 9: 350,000 10: 700,000 11: 1,500,000 12: 3,000,000 13: >3,000,000
maximumDisplayScale	1	{1} to {13}	Integer	1: <4,000 2: 4,000 3: 8,000 4: 12,000 5: 22,000 6: 45,000 7: 90,000 8: 180,000 9: 350,000 10: 700,000 11: 1,500,000 12: 3,000,000 13: >3,000,000
minimumDisplayScale	1	{1} to {13}	Integer	1: <4,000 2: 4,000 3: 8,000 4: 12,000 5: 22,000 6: 45,000 7: 90,000 8: 180,000 9: 350,000

**Comment [N72]:** BSH: This row mentions optimum scale. In Chapter 4.6.1.1 no optimum scale is mentioned, maximum scale and minimum scale, only. In my opinion there is no need for an optimum scale.

**Comment [N73]:** UKHO: display scales are 1,1 does this need to allow for 1,\* so does not support data coverages with different

UKHO: What happens to display in the ECDIS when the maximumDisplayScale is set to (1). Does the system allow the user unlimited zoom in?

Name	Multiplicity	Value	Type	Remarks
				10: 700,000 11: 1,500,000 12: 3,000,000 13: >3,000,000
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 4 : Lowest low water 5 : Mean low water 6 : Lowest low water springs 7 : Approximate mean low water springs

Name	Multiplicity	Value	Type	Remarks
				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	S-100_DataFormat	
otherDataTypeDescription	0..1		CharacterString	
boundingBox	1		EX_GeographicBoundingBox	
boundingPolygon	1..*		EX_BoundingPolygon	
comment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
checksum	1		CharacterString NonNegativeInteger	
layerId	1..*	{1} to {3}	CharacterString	Identifies the relationship to other layers that are required to view the complete data set. <ol style="list-style-type: none"> <li>1. Scale Independent</li> <li>2. Scale Dependent</li> <li>3. Complete</li> </ol>

### 12.1.3 Support File Metadata

Name	Multiplicity	Value	Type	Remarks
S101_SupportFileDiscoveryMetadata	-		-	-
fileName	1		CharacterString	
<a href="#">fileLocationfilePath</a>	1		CharacterString	Full location from the exchange set root directory
Purpose	1	{1} to {3}	class S-100_SupportFilePurpose	<ol style="list-style-type: none"> <li>1. New – A file which is new</li> <li>2. Replacement – A file which replaces an existing file</li> <li>3. Deletion – deletes an existing file</li> </ol>
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		S-100_ProductSpecification	Version of S-101
dataType	1	{1} to {4}	class S-100_SupportFileFormat	<ol style="list-style-type: none"> <li>1. TXT = Text files</li> <li>2. XML = Text files</li> <li>3. HTM = Text files</li> <li>4. TIFF = Picture files</li> </ol>
dataTypeVersion	1		CharacterString	The version number of the dataType
Comment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
checksum	1		CharacterString	
<a href="#">digitalSignatureReference</a>	0..1		CharacterString	Reference to the appropriate digital signature algorithm
digitalSignatureValue	0..1		CharacterString	

**Comment [N74]:** 2J: What is the purpose of digitalSignatureReference and digitalSignatureValue?

Ed NOTE: I think this comes from S-63 metadata

#### 12.1.4 Exchange Catalogue File Metadata

The catalogue file is defined in XML schema language and the data set files are encoded as ISO/IEC 8211 data records, fields, and subfields. 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 S-100_CatalogueIdentifier	Uniquely identifies this exchange catalogue
EditionNumber	1		CharacterString	The edition number of this exchange catalogue
Contact	1		S-100_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

Name	Multiplicity	Value	Type	Remarks
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	1	{1} to {2}	CharacterString	1. ZIP 2. RAR
sourceMedia	1			
replacedData	1			If a data file is canceled is it replaced by another data file
dataReplacement	0..1			<a href="#">CellDataset</a> name

## 12.2 Language (S-57 PS 3.11)

The exchange language must be English. Other languages may be used as a supplementary option. In general, this means that when a national language is used in the textual national attributes the English translation must also exist in the textual international attributes. 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.](#)

**Comment [N75]:** 2J: References to national textual attributes made obsolete by new model of text attributes

Delete text "In general...used in international attributes."

**Comment [N76]:** JP: From 4.3.4.5

## Annex A - Data Classification and Encoding Guide

## ANNEX B - NORMATIVE

### Data Product format (encoding)

#### B1 Introduction

##### B1.1 Data set files

The order of data in each base or update [eohdataset](#) 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 [eohdataset](#) 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 (RUI) is always set to insert. When encoding updates it can be set to insert, modify or delete.

### B1.5 Base celldataset structure

Base dataset file

```

--<1>- Data Set General Information record
|
|  --<1>-DSID (11): 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>-CRID (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 (*4): Information Association field
|
--<0..*>-- Point record
|
|  --<1>-PRID (4): Point Record Identifier field
|  --<0..*>-INAS (*4): Information Association field
|  alternate coordinate representations
|  *-<1>-C2DI (2): 2-D Integer Coordinate field
|  *-<1>-C3DI (4): 3-D Integer Coordinate field
|
--<0..*>-- Multi Point record
|
|  --<1>-MRID (4): Multi Point Record Identifier field
|  --<0..*>-INAS (*4): Information Association field
|

```

```

| alternate coordinate representations
|
|*-<0..*>-C2DI (*2): 2-D Integer Coordinate field
|
|*-<0..*>-C3DI (*4): 3-D Integer Coordinate field
|
--<0..*>-- Curve record
|
|--<1>-CRID (4): Curve Record Identifier field
|
|  -<0..*>-INAS (*4): Information Association field
|
|  -<1>-PTAS (*3): Point Association field
|
|  -<1>-SEGH (1): Segment Header field
|
|    -<1..*>-C2DI (*2): 2-D Integer Coordinate field
|
--<0..*>-- Composite Curve record
|
|--<1>-CCID (4): Composite Curve Record Identifier field
|
|  -<0..*>-INAS (*4): Information Association field
|
|  -<0..*>-CUCO (*3): Curve Component field
|
--<0..*>-- Surface record
|
|--<1>-SRID (4): Surface Record Identifier field
|
|  -<0..*>-INAS (*4): 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 (*4): Information Association field
|
|  -<0..*>-SPAS (*6): Spatial Association field
|
|  -<0..*>-FEAS (*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	DSLGL	"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 <sup>7</sup> }	b14	Floating point to integer multiplication factor for the x-coordinate or longitude
Coordinate multiplication factor for y-coordinate	CMFY	{10 <sup>7</sup> }	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.

#### B1.5.4.1 Information Association field

Field Tag: <b>INAS</b>	Field Name: Information Association
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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	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.

#### B1.5.4.2 Coordinate Reference System Record Identifier field - CRID

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

#### B1.5.4.3 Coordinate Reference System Header field - CRSH

Subfield name	Label	Value	Format	Comment
CRS index	CRIX			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 vertical datum	A()	
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()	

#### B1.5.4.4 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

#### B1.5.4.5 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()	

#### B1.5.5 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 <sup>32</sup> -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

#### B1.5.6 2-D Integer Coordinate field – C2DI

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
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### B1.5.7 3-D Integer Coordinate field– 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)

#### B1.5.7.1 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

#### B1.5.7.2 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

#### B1.5.7.3 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

#### B1.5.7.4 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

#### B1.5.7.5 Segment Header field - SEGH

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

**B1.5.7.6 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 <sup>32</sup> -2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUI	{1}	b11	{1} - Insert

**B1.5.7.7 Curve Component field - CUCCO**

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

**B1.5.7.8 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 <sup>32</sup> -2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUI	{1}	b11	{1} - Insert

**B1.5.7.9 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

**B1.5.8 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 <sup>32</sup> -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	RUI	{1}	b11	{1} - Insert

**B1.5.9 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 <sup>32</sup> -2
Feature identification subdivision	FIDS		b12	Range: 1 to 2 <sup>16</sup> -2

**B1.5.10 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

**B1.5.11 Feature Association – FEAS**

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	ASCD		b12	A valid code for the association
Role Code	RLCD		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1}	b11	{1} - Insert

**B1.5.12 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

### B1.5.13 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 Update Instruction	MUIN	{1}	b11	{1} - Insert

### B1.6 Update dataset structure

Update dataset file

```

--<1>- Data Set General Information record
|
|--<1>-DSID (11): 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 (*4): Information Association field

--<0..*>-- Point record
|
|--<1>-PRID (4): Point Record Identifier field
|
|--<0..*>-INAS (*4): Information Association field
|
|   alternate coordinate representations
|
|--<1>-C2DI (2): 2-D Integer Coordinate field
|
|--<1>-C3DI (4): 3-D Integer Coordinate field

--<0..*>-- Multi Point record
|
|--<1>-MRID (4): Multi Point Record Identifier field
|
|--<0..*>-INAS (*4): Information Association field
|
|--<0..1>-COCC (3): Coordinate Control field
|
|   alternate coordinate representations
|
|--<0..*>-C2DI (*2): 2-D Integer Coordinate field
|
|--<0..*>-C3DI (*4): 3-D Integer Coordinate field

--<0..*>-- Curve record

```

**Comment [N77]:** JP: Although described as '--<1>-DSSI', as '--<0..1>-DSSI' is better. Because DSSI field is not used, when we issue the cancel ER.

Update dataset file  
|--<1>- Data Set General Information record  
|--<1>-DSID  
|--<0..1>-DSSI

```

|
|  |--<1>-CRID (4): Curve Record Identifier field
|  |  |--<0..*>-INAS (*4): 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..*>-C2DI (*2): 2-D Integer Coordinate field
|
|--<0..*>-- Composite Curve record
|  |--<1>-CCID (4): Composite Curve Record Identifier field
|  |  |--<0..*>-INAS (*4): 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 (*4): 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 (*4): Information Association field
|  |  |--<0..*>-SPAS (*6): Spatial Association field
|  |  |--<0..*>-FEAS (*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()	{1} – 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	DSLGL	"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 <sup>7</sup> }	b14	Floating point to integer multiplication factor for the x-coordinate or longitude
Coordinate multiplication factor for y-coordinate	CMFY	{10 <sup>7</sup> }	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
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#### 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: <b>INAS</b>	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 <sup>32</sup> -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 2-D Integer Coordinate field – C2DI

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

### B1.6.8 3-D Integer Coordinate field– 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)

#### B1.6.8.1 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 <sup>32</sup> -2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUII	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

#### 12.2.1.1

#### B1.6.8.2 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 <sup>32</sup> -2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUII	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

#### B1.6.8.3 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

#### B1.6.8.4 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 <sup>32</sup> -2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUII	{1},{2} or {3}	b11	{1} - Insert

		{3}		{2} - Delete {3} - Modify
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#### B1.6.8.5 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

#### B1.6.8.6 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

#### B1.6.8.7 Segment Header field - SEGH

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

#### B1.6.8.8 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 <sup>32</sup> -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

#### B1.6.8.9 Curve Component Control field - CRPC

Subfield name	Label	Value	Format	Comment
Curve Component update instruction	CCUI		b11	{1} - Insert {2} - Delete {3} - Modify
Curve Component index	CCIX		b12	Record identifier of the referenced record
Number of Curve Components	NCCO		b12	{1} - Forward {2} - Reverse

**B1.6.8.10 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

**B1.6.8.11 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 <sup>32</sup> -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

**B1.6.8.12 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

**B1.6.9 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 <sup>32</sup> -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

**B1.6.10 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 <sup>32</sup> -2
Feature identification subdivision	FIDS		b12	Range: 1 to 2 <sup>16</sup> -2

**B1.6.11 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

### B1.6.12 Feature Association – FEAS

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	ASCD		b12	A valid code for the association
Role Code	RLCD		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

### B1.6.13 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

**B1.6.14 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 Update Instruction	MUIN	{1} or {2}	b11	{1} - Insert {2} - Delete

## Annex C – Normative

### Business Rules of S-101

#### C.1 Overview

##### C.1.1 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).

#### C.3 Data Set Identification

S-101 has aligned the maximum and minimum display scales to the standard radar ranges. This is specified in the spatial resolution of the dataset and further specified in the metadata.

Standard RADAR Ranges	Scale
	>1:3,000,000
200 NM	1:3,000,000
96 NM	1:1,500,000
48 NM	1:700,000
24NM	1:350,000
12 NM	1:180,000
6 NM	1:90,000
3 NM	1:45,000
1.5 NM	1:22,000
0.75 NM	1:12,000
0.5 NM	1:8,000
0.25 NM	1:4,000
	<=1:2,000

Table 1: Standard Display Scales

## C.4 Data Content and structure

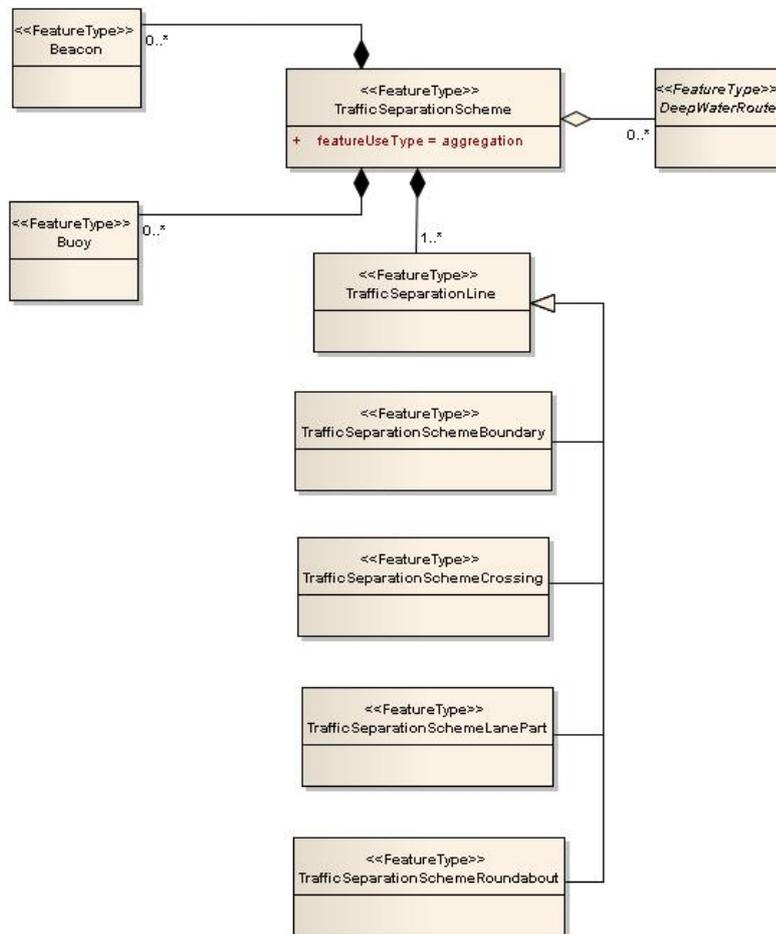
### C.4.3 Feature Catalogue

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.

#### C.4.3.3.3 Composition

A composition is a strong aggregation. Therefore if the main feature type is deleted, then all of its component feature types are deleted.

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



#### C.4.3.4 Information Types

NEED TO HAVE A CASE ON HOW INFORMATION TYPES ARE TO BE USED

#### C.4.3.5.2 Complex Attributes

NEED TO HAVE A CASE ON HOW COMPLEX ATTRIBUTES ARE TO BE USED

#### C.4.3.5.3.1 Text Placement

NEED TO HAVE WORKED EXAMPLES FOR TEXT PLACEMENT IN BOTH NORTH UP AND HEADS UP.

### C.4.5 Dataset Structure

Datasets may be structured in several ways. They are:

- Complete dataset: all ENC features needed are contained within this dataset
- Scale independent and scale dependent: When used together in the same geographic location these two datasets form a complete dataset suitable for use in navigation. If one of the two datasets are missing then a warning must be given to indicate that this is not a suitable for navigation.

#### C.4.5.3 Scale Independent and Scale Dependent Datasets

The following are additional business rules that must be implemented for Scale Independent and Scale dependent data.

Dataset metadata element *layerId* describes the type of dataset (SI/SD/complete). This element is defined in the S-101 discovery metadata.

SCAMIN and SCAMAX attributes may or may not be coded for SI features. If coded, they indicate the limiting scales at which the feature is expected to be displayed. This can be used to avoid situations where small scale charts display minor lights. Alternatively global display rules can be formed to move more of the display priority processing over to the ECDIS.

#### Metadata rules

Scale Independent datasets: Dataset metadata elements *maximumDisplayScale* must be set to 1:300,000 and *minimumDisplayScale* must be set to 1:2,000, unless SCAMAX or SCAMIN are encoded on a specific feature, then that feature must display according to the SCAMAX and SCAMIN values.

#### Packaging rules

1. There can be zero, one, or more than one scale independent [ee#dataset](#) contained within an exchange set.
2. The coverage of a SD [ee#dataset](#) in the exchange set must be within the coverage of the scale independent [ee#dataset](#)s in the same exchange set.

**Comment [N78]:** BSH: I'm not sure if SCAMIN shouldn't be made mandatory for scale independent datasets, because, there should be consistency between adjacent datasets of different HO's.

3. (File naming rule for SI data was considered but is not technically necessary because the discovery metadata designates files as SI/SD. Convenience during production and maintenance may be improved with a naming convention which distinguishes between SI/SD.)

#### Data set rules

1. A scale independent ~~cell~~dataset must only contain the following meta features
  - Mandatory: DataCoverage (which ~~shall~~must be provided)
  - Optional: "Navigational system of marks" (M\_NSYS).
2. Scale dependent datasets must not contain any of the feature classes designated as a scale independent feature.
3. Scale independent datasets must not contain any feature class that is designated as a scale dependent feature.

#### Application rules for ECDIS

1. Scale Independent data outside the coverage of available scale dependent datasets must not be part of the display.
2. Applications must verify that all DataCoverages of loaded Scale Dependent data are in the same geographic area as the DataCoverage for the loaded Scale Independent dataset.

### C.4.6 Display

#### C.4.6.1.1 Algorithm for Dataset Loading and Unloading

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

Create selection List

1. 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**
2. 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**
3. 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

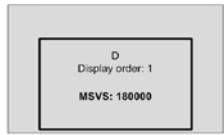
If the MSVS is larger than the **maximumDisplayScale** of an area within the window, turn on overscale indication.

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.

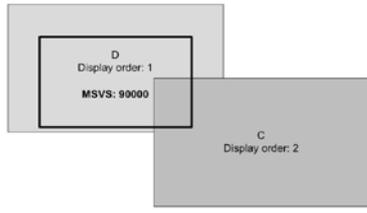


ECDIS Graphics Window

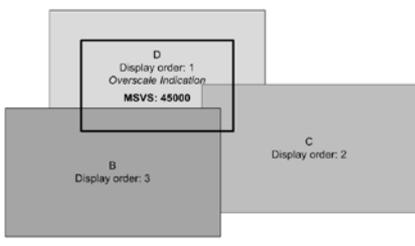
**Scenario 1**



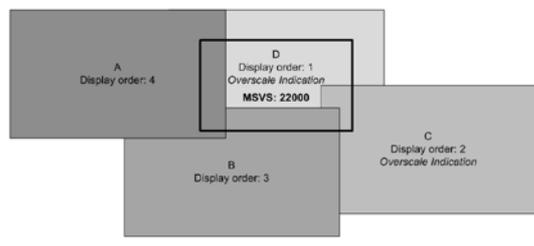
**Scenario 2**



**Scenario 3**



**Scenario 4**



The example of above works through four scenarios and uses four different types of **DataCoverage** with different MAXDSC and MINDSC. They are denoted as area A, B, C and D.

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

#### 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.

## C.9 Portrayal

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

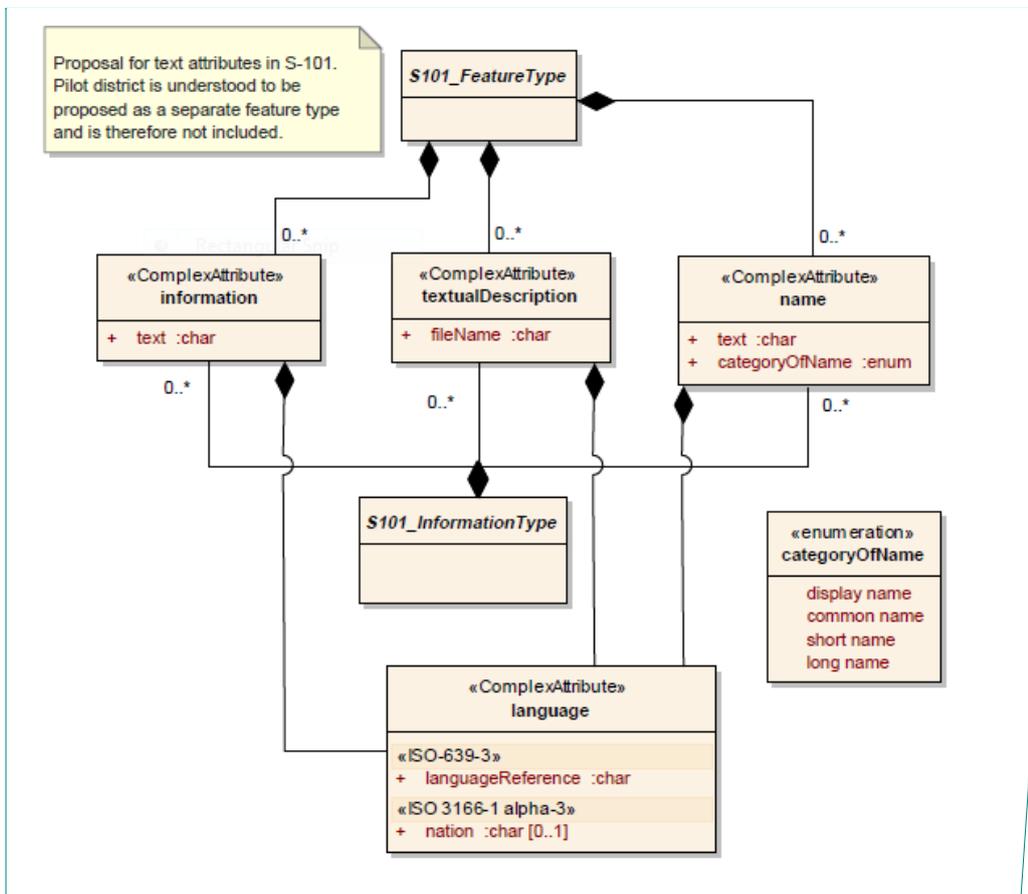
### Display of Names

In S-101 Names are modelled as a complex attribute. As part of this model there is a new attribute categoryOfName. When the user turns text on, then the name that has display name encoded must be the name that is displayed on the screen.

EXAMPLE: A light is encoded with the full name as a long name: Micklefirth lighted beacon "9", it is also encoded with a short name: "9". The display name is toggled for the short name; therefore the ECDIS must only display "9" when text is turned on. The long name must be visible in the pick report.

**Comment [N79]:** 2J: Don't specify the pick report here, just use it as an example

Change last sentence to "The long name may be displayed in the pick report and elsewhere"



**Comment [N80]:** 2J: A new simplified model was developed in discussions with SNPWG.

Should be updated with model resulting from discussions with SNPWG.

ED note: Haven't seen this model yet

UKHO: Suggest names will be covered in portrayal rules, no need to explain here.

Remove rules for display of names. This will be covered in the DCEG and Portrayal Catalogue.

## 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 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

Scenarios –

New Attribute

New ennumerant

New Feature

Feature changes type.

### C.11.3 Dataset

#### C.11.3.1 Data Sets

NEED WORKED EXAMPLES OF NON OVERLAPPING DATASETS

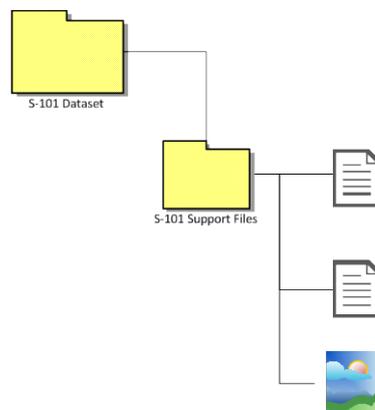
#### C.11.3.3 New Editions, Re-Issues and Updates

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.

### C.11.4 Support Files

#### C.11.4.2 Support File Management

Each dataset must have a corresponding support file folder. Support files must be managed using the following folder structure:



**Comment [N81]:** 2J: Realizing this part of 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 files and terminate support file.

**Comment [N82]:** UKHO: Support file management, should not specify the folder structure so specifically. Remove folder structure or make a recommendation.

2J: Folder structure should take into account the possibility of different languages.

Put text files (TXT, HTML, XML) and any other support files containing text into sub-folders named by ISO language codes.

## ANNEX D – Feature Catalogue

## ANNEX F – Portrayal Catalogue