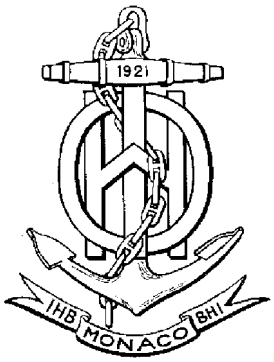
INTERNATIONAL HYDROGRAPHIC ORGANIZATION



IHO GEOSPATIAL STANDARD FOR HYDROGRAPHIC DATA

Draft 0.0.4 – September 2010

Special Publication No. 101
Electronic Navigational Chart Product Specification

Published by the
International Hydrographic Bureau
MONACO

Version Number	Date	Author	Purpose
0.1	May 2009	J. Powell	Initial Draft
0.2	June 2010	J. Powell	Merged all the phases back into a single document
0.0.3	July 2010	J. Powell	Added comments from AHO
0.0.4	September	J. Powell	Revised based on FG discussions

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1 Overview

1.1 Introduction

1.2 References

1.3 Terms, definitions and abbreviations

1.3.1 Terms and Definitions

Cell
A cell is a geographical area containing ENC data.

ENC
The latest version of official data carried by a vessel for the intended voyage.

ENC Product Specification
The set of specifications intended to enable Hydrographic Offices to produce 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.

point
0-dimensional **geometric primitive**, representing a position

curve
1-dimensional **geometric primitive**, representing the continuous image of a line

NOTE: The **boundary** of a **curve** is the **set** of **points** at either end of the **curve**. If the curve is a cycle, the two ends are identical, and the curve (if topologically closed) is considered to not have a boundary. The first **point** is called the **start point**, and the last is the **end point**. Connectivity of the curve is guaranteed by the "continuous image of a line"

curve segment
1-dimensional **geometric object** used to represent a continuous component of a **curve** using homogeneous interpolation and definition methods

NOTE: The **geometric set** represented by a single curve segment is equivalent to a **curve**

1.3.2 Abbreviations

IHO	International Hydrographic Organization
ENC	Electronic Navigational Chart
SENC	System Electronic Navigational Chart

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.

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.

Spatial Extent:

Description: Areas specific to marine navigation.

East Bounding Longitude: 180

West Bounding Longitude: -180

North Bounding Latitude: 88

South Bounding Latitude -88

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

1.5 Data product specification metadata

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

Title: The International Hydrographic Organization Electronic Navigational Chart Product Specification

S-100 Version: 1.0.0

S-101 Version: 0.1.0

Date: June 25, 2010

Language: English

Classification: Unclassified

Contact: International Hydrographic Bureau (IHB)

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MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
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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 be made available via the IHO web site. Maintenance of the Product Specification shall conform to IHO Technical Resolution 2/2007 (revised 2009).

2 Specification Scopes

Scope ID: Root scope

Level: Dataset

Level name: ENC Dataset

3 Data Set Identification

A data set that conforms to this Product Specification will be identifiable by the discovery metadata that supports it.

Title: Electronic Navigational Chart

Alternate Title: ENC

Abstract: When an S-101 ENC is produced it must be 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: Optimum display scale will be the intended viewing scale of the data within a dataset and must be one of the scales listed in the table below. The display scales for ENC have been aligned with the standard RADAR ranges and are as follows:

Standard RADAR Ranges	Optimum Display 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

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

Language: English

Classification: Unclassified

Spatial Representation Type: Vector

Point of Contact: Producing Hydrographic Office

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

4 Data Content and structure

Comment [JLP1]: NOTE: some of these concepts will get implemented in later phases of S-101.

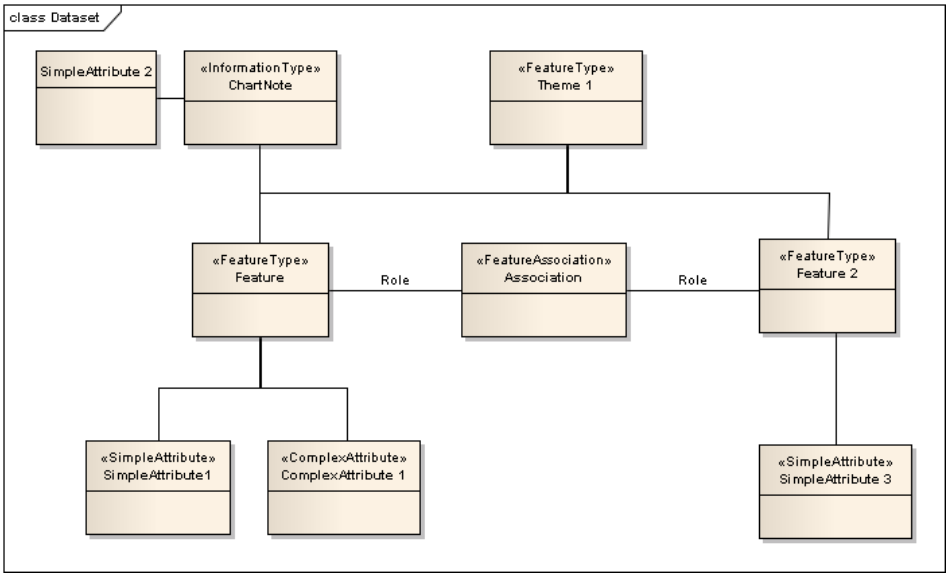
4.1 Introduction

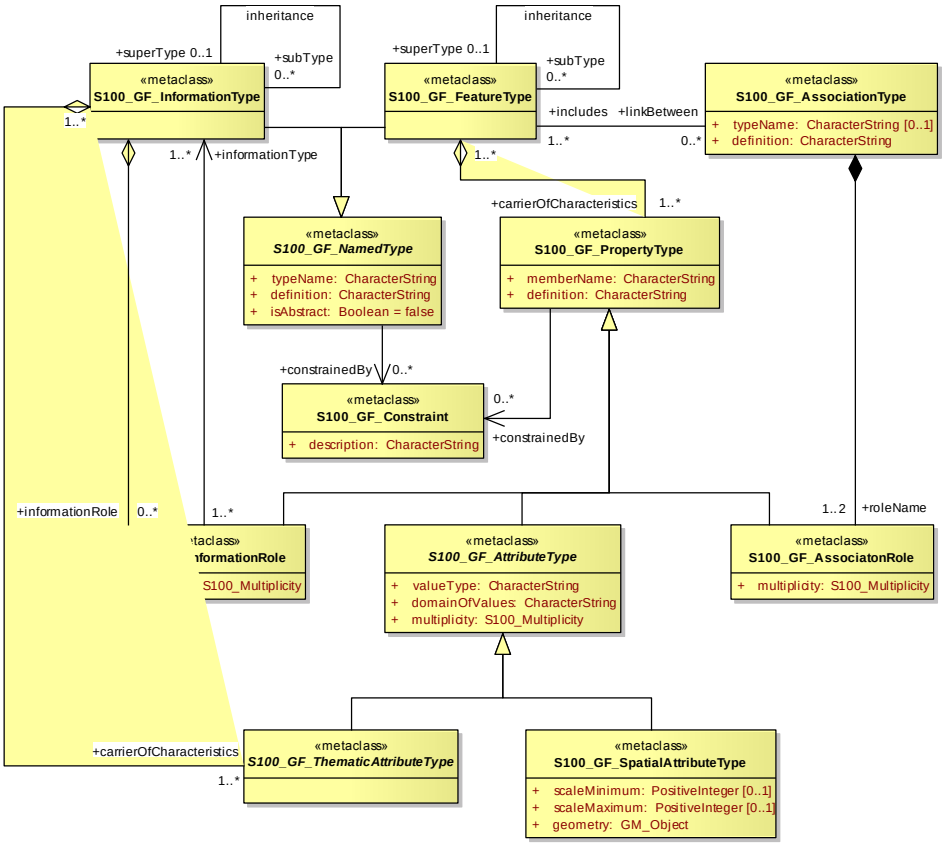
An S-101 ENC is a feature-based product. This section contains the product Application Schema expressed in UML and an associated Feature Catalogue. The Feature Catalogue provides a full description of each feature type including its attributes, attribute values and relationships in the data product.

4.2 Application Schema

Comment [YUN2]: ACTION: Barrie to extract the relevant parts of the GFM and also to extract the relevant spatial that will be used.

S-101 is based on General Feature Model (GFM) from S-100. The GFM is the conceptual model and the implementation is defined in the Feature Catalogue.





4.2.1 Feature

Features contain descriptive attributes and do not contain any geometry (i.e. information about the shape and position of a real world entity). Spatial types may relate to Information Types. A feature is located by a relationship to one or more spatial type. Information Types and Aggregated feature types may exist without referencing a spatial type, but each spatial feature must be referenced by a feature type.

4.2.2 Spatial

Comment [YUN3]: Include the Spatial here

In certain circumstances, the symbolisation of points, curves, and surfaces may need to be suppressed. In order to suppress these spatial features the masked Spatial Type field structure is used.

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

4.3.2 Feature Types

4.3.2.1 Geographic

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

4.3.2.2 Meta (S-57 PS 3.4)

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 Data**Coverage** provides an exhaustive, non-overlapping coverage of the entire cell.

Comment [YUN4]: This is amended based on the result of CATCOV 2 discussion

4.3.2.3 Aggregated (S-57 PS 3.9)

An Aggregated Feature Type is a feature which is made up of component features. See clause ?? on Feature Associations.

EXAMPLE 1 Traffic Separation Scheme feature of type aggregation may consist of Traffic Separation Lane Parts, Precautionary Area, etc. (Feature Association is a Composition.

EXAMPLE 2 A range of type aggregation is composed of a Navigation Line, front beacon, rear beacon and recommended track. (Feature Association is an Aggregation)

4.3.2.4 Theme

Theme features are a special kind of collection. They do not define a feature itself but group other features together. The reasons for the grouping are mostly thematic, other reasons are possible. Each feature may belong to more than one theme. Themes are therefore not mutually exclusive. Since the kind of association from a theme feature to its members (and vice versa) is not variable, the encoding of this type of association is different from the other feature associations. Themes are encoded using the “Theme Association Field” [THAS].

4.3.2.4.1 Skin of the Earth Theme (S-57 PS 3.10.1)

Themes are normally defined in the Feature Catalogue however in this case there are constraints which have to be observed. Skin of the Earth features are a set of geo features of geometric type area that do not overlap each other and form a continuous surface named “Skin of the Earth”. The features listed below represent the only allowable features in this theme.

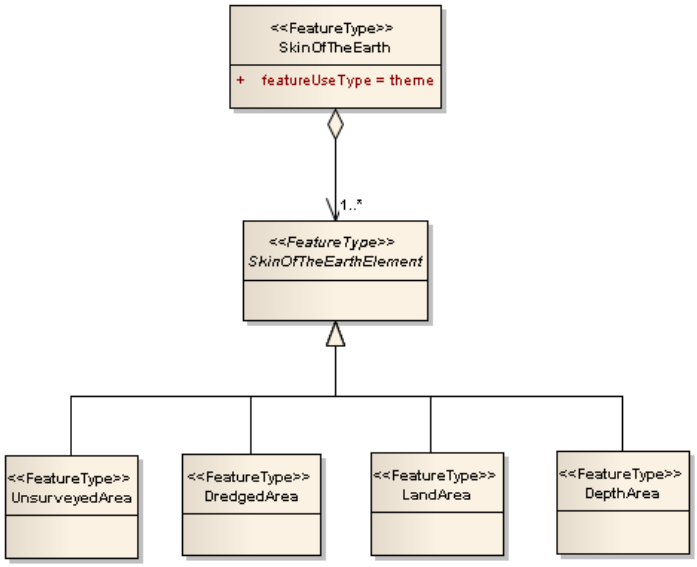
DepthArea (**DEPARE**)

DredgedArea (**DRGARE**)

LandArea (**LNDARE**)

UnsurveyedArea (**UNSARE**)

Each area covered by a meta feature Data**Coverage** with categoryOfCoverage = 1 must be totally covered by a set of geo features of type area 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.



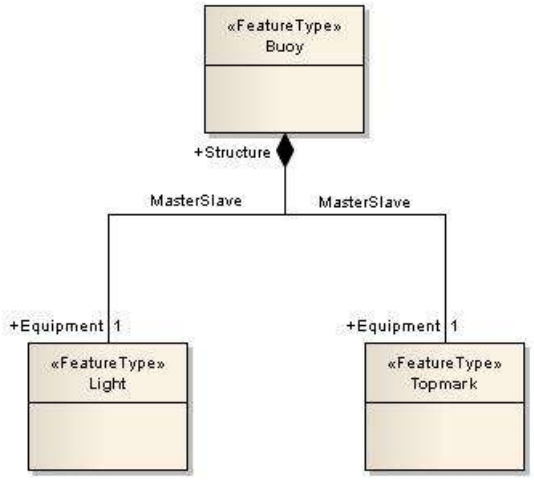
4.3.3 Feature Relationship

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 subclauses.

4.3.3.1 Association

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

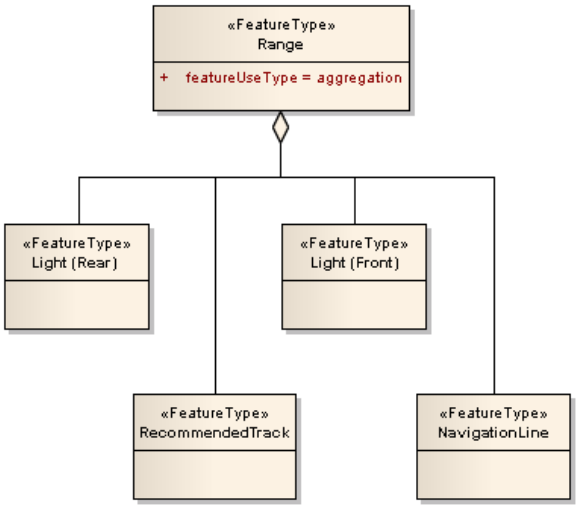
EXAMPLE In an association a wreck is marked by a cardinal buoy and the cardinal buoy marks the wreck.



4.3.3.2 Aggregation

An aggregation is a relationship between two feature types, in which one of the feature types plays the role of a container and the others play the role of containee.

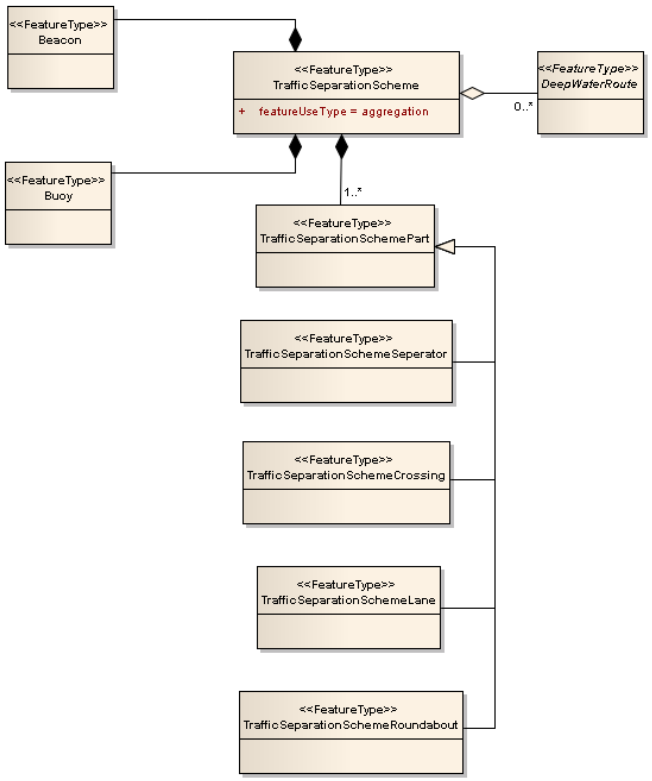
EXAMPLE Navigation Line, recommended track, rear and front beacon are a member of a range group.



4.3.3.3 Composition

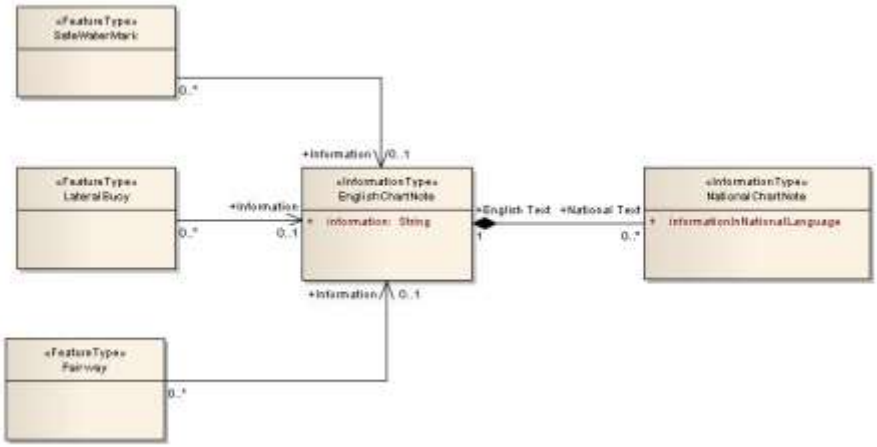
A composition is a strong aggregation. In a composition, if a container object is deleted then all of its containee objects are deleted as well.

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



4.3.4 Information Types

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



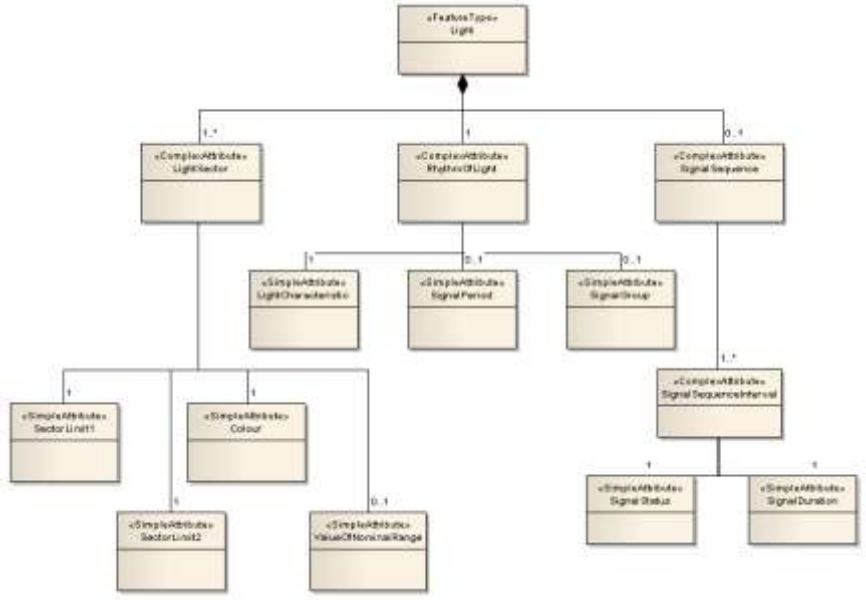
4.3.5 Attributes

4.3.5.1 Numeric Attribute Values (S-57 PS 3.5.4)

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.



4.3.5.3 Text Attribute Values (S-57 PS 3.5.5)

Character strings must be encoded using the character set defined in ISO 10646-1, in Unicode Transformation Format-8 (UTF-8).

4.3.5.3.1 Text Placement

The text encoded in the object name attribute of a feature can be given an anchor point that specifies the placement of the text within an ECDIS. When a feature is encoded with an object name and the compiler wishes the text to appear in a specific place a text placement complex attribute must be encoded detailing the true bearing in degrees and the distance value from the feature.

4.3.5.4 Mandatory Attribute Values (S-57 PS 3.5.2)

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.

4.3.5.5 Missing Attribute Values (S-57 PS 3.5.1)

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 (S-57 PS 3.1)

Each real world feature and instances of information type within an ENC must have a unique universal Feature Object Identifier.

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. For example, the same feature may appear in different optimum display scales, or a feature may be split by the cell 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 Scale Independent and Scale Dependent Cells

ENC producers can make the decision to partition a set of navigational data into two separate cells based on the scale dependent and scale independent geometric properties of features. This concept splits a collection of data into two groups. The primary advantage of this structure is that receiving systems only hold the scale independent features once, instead of multiple occurrences at different display scales. This in turn effectively reduces the file size of an ENC exchange set and increases the speed at which updates can be applied to cells.

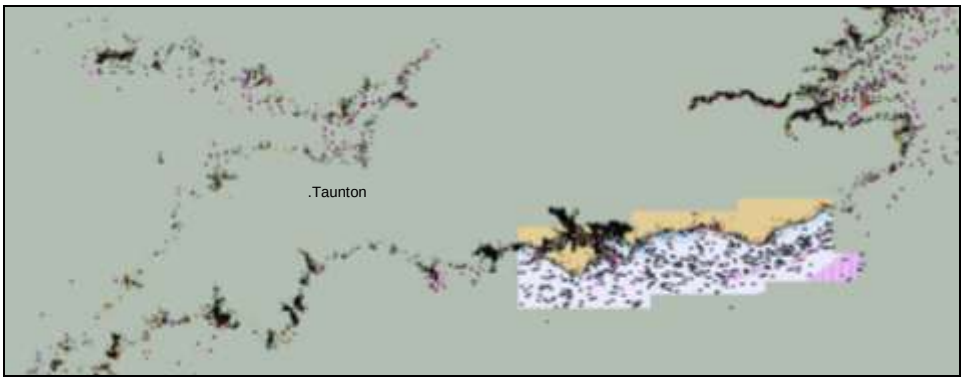


Figure ?? A scale independent cell overlaid with three scale dependant cells.

4.5.1 Scale Independent Dataset

There can be more than one scale independent cell contained within an exchange set. To view scale independent data in a receiving system there must be an accompanying cell containing the scale dependent data for that area. A scale independent cell will not contain any meta features. A nation responsible for the population of a scale independent data set will be obligated to produce scale dependent data sets of the same area. The display scale of the cell must be set to 0. All features within a scale independent cell must have the attribute, scale minimum and (scale max?) encoded.

4.5.1.1 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 cell.

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		
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	
SILTNK	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		

4.5.2 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 display scale may overlap. However, data within must not overlap. Therefore, in the area of overlap only one dataset may contain data.

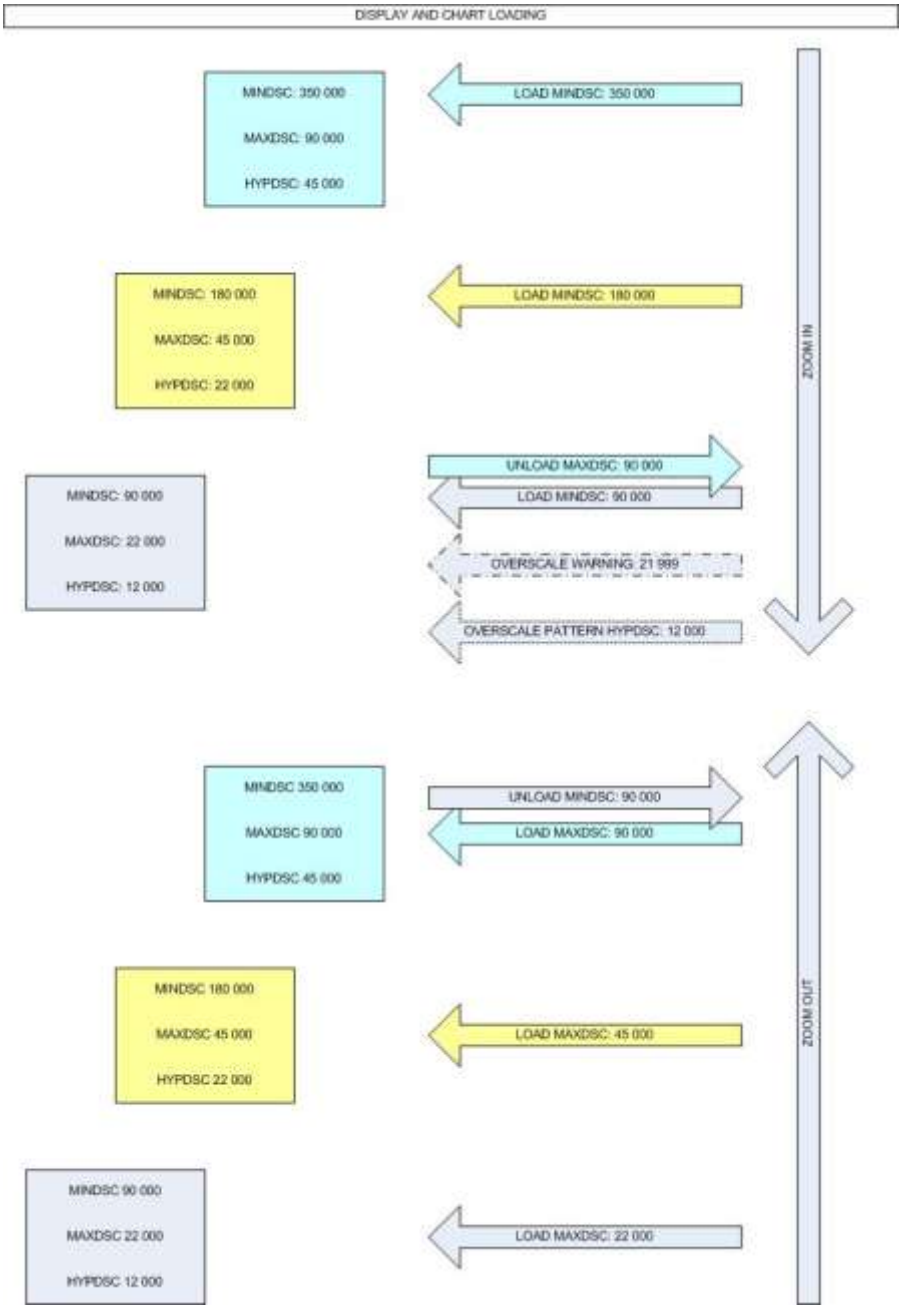
4.6 Optimum Display

Display scale will be the optimum viewing scale of the data within the dataset. In addition to the optimum display scale the producer will encode the maximum and minimum display scales an ENC can be viewed at.

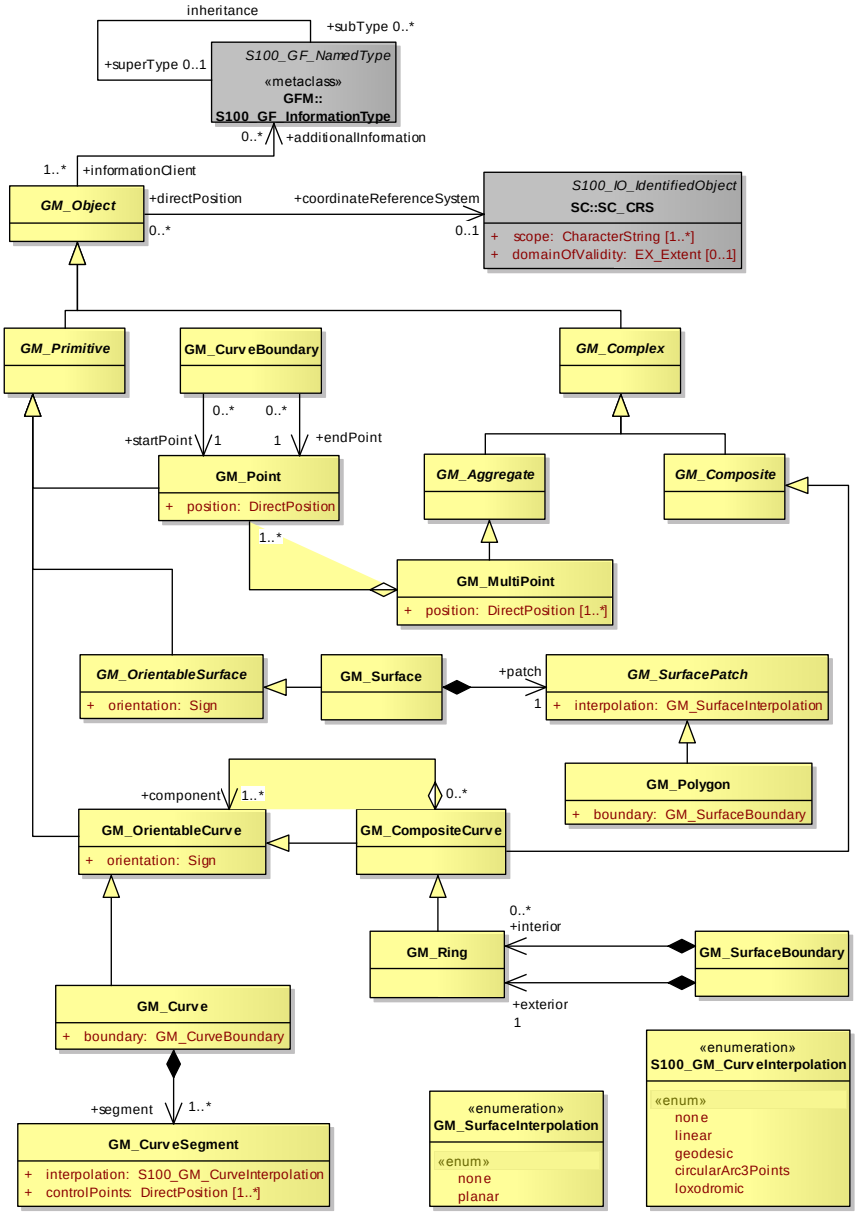
It will not be possible for a user to zoom past a cells display scale maximum or minimum values. In the event a user wishes to zoom into the product see the detail of the data in greater clarity a larger display scale cell should be loaded. Conversely if the user wished to get an overview of an area and zooms out a smaller display scale chart will load when the minimum value is reached. If there is no smaller or larger scale information available systems will not allow users to unload the current cell or zoom past the display scale max and min values. Producers of the ENC data have made the informed decision that data viewed beyond the max and min display scales would be degraded to such an extent that the product would become unsafe.

Comment [JLP5]: OUTSTANDING ACTIONS:

1. Need to define MINDSC,MAXDSC,HYPDSC
2. Need to define what goes in the PS
3. Need to define what goes in the DCCG
4. Need to provide implementation guidelines


DISPLAY AND CHART LOADING
MINDSC: 350 000
MAXDSC: 90 000
HYPDSC: 45 000
LOAD MINDSC: 350 000
ZOOM IN
MINDSC: 180 000
MAXDSC: 45 000
HYPDSC: 22 000
LOAD MINDSC: 180 000
MINDSC: 90 000
MAXDSC: 22 000
HYPDSC: 12 000
UNLOAD MAXDSC: 90 000
LOAD MINDSC: 90 000
OVERSCALE WARNING: 21 989
OVERSCALE PATTERN HYPDSC: 12 000
MINDSC 350 000
MAXDSC 90 000
HYPDSC 45 000
UNLOAD MINDSC: 90 000
LOAD MAXDSC: 90 000
ZOOM OUT
MINDSC 180 000
MAXDSC 45 000
HYPDSC 22 000
LOAD MAXDSC: 45 000
MINDSC 90 000
MAXDSC 22 000
HYPDSC 12 000
LOAD MAXDSC: 22 000

4.7 Geometry (S-57 PS 2.3 and 3.8)



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.
- 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).
- 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.

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

- Coincident linear geometry must be avoided when there is a dependency between features.
- The interpolation on GM_CurveSegment must be loxodromic.

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.

5 Coordinate Reference Systems (CRS)

5.1 Introduction (S-57 PS 4.1)

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 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.

5.2 Horizontal Coordinate Reference System (S-57 PS 4.1)

For ENC the geodetic datum of the horizontal CRS must be WGS 84. No projection is to be used. If the CRS WGS84 is not defined in the encoding by referencing then it must be fully defined, encoding all parameters and referenced to a geodetic Coordinate Reference System which incorporates an ellipsoidal coordinate system with axes graduated in degrees.

5.3 Vertical CRS for Soundings (S-57 PS 4.2)

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.

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

5.4 Coordinate Units (S-57 PS 4.4)

Units to be used in an ENC:

- Position: latitude and longitude in decimal degrees.
- Depth: metres.
- Height: metres.
- Positional accuracy: metres.
- Distance: nautical miles or metres.
- Time: seconds.
- Bearings: decimal degrees.

Comment [YUN6]: Find a new home for this info, either in the intro or in the metadata section

Comment [YUN7]: ACTION: Look at S-100 data quality section. Write something for Barrie to take to DQWG regarding this section , what should go into this section etc...

6 Data Quality (S-57 UOC)

6.1 Introduction

Data quality comprises the following:

- source of data;
- accuracy of data;
- up-to-datedness of data.

Data quality is considered to be meta information. As such, it can be encoded at three different levels.

Data quality information is considered to be application specific. Therefore, rules for encoding data quality must be defined by the relevant Product Specification.

6.2 Quality, Reliability and Accuracy of Bathymetric Data

Information about quality, reliability and accuracy of bathymetric data is given using:

- the meta feature **QualityOfData** for an assessment of the quality of bathymetric data,
- the meta feature **SurveyReliability** for additional information about the survey,
- the attributes QUASOU, SOUACC and TECSOU on groups of soundings or individual features,
- the attributes POSACC and QUAPOS on the spatial features.

For the mariner, **QualityOfData** provides the most useful information. Therefore, the use of **QualityOfData** is mandatory for areas containing depth data or bathymetry.

More detailed information about a survey may be given using **SurveyReliability**. For example, in incompletely surveyed areas, lines of passage soundings may be indicated as such using a linear **SurveyReliability** feature. This information is more difficult for the mariner to interpret. Therefore, the use of **SurveyReliability** is optional.

For individual features (wrecks, obstructions etc), or small groups of soundings, QUASOU, SOUACC and TECSOU may be used to provide additional information about quality and accuracy.

6.2.1 Quality of bathymetric data

The meta feature **QualityOfData** defines areas within which uniform assessment exists for the quality of bathymetric data, and must be used to provide an assessment of the overall quality of bathymetric data to the mariner. Areas of a cell containing depth data or bathymetry must be covered by one or more **QualityOfData**, which must not overlap.

6.2.2 Survey reliability

The survey reliability may be encoded using the meta feature **SurveyReliability**.

6.2.3 Quality of sounding

If it is required to encode the quality of sounding, it must be done using the attribute QUASOU on either the meta feature **SurveyReliability** or on individual geo features (e.g. **Sounding**).

The quality of sounding must not be encoded using QUASOU on the depth geo feature, unless it is different to the value of QUASOU populated on an encoded **SurveyReliability** feature covering the geo feature.

6.2.4 Sounding accuracy

Sounding accuracy is encoded using the attribute CATZOC on the meta feature **QualityOfData**. If it is required to encode additional sounding accuracy information, it must be done using the attribute SOUACC on either the meta feature **QualityOfData** or on individual geo features (e.g. **Sounding**).

The accuracy of sounding must not be encoded using SOUACC on the depth geo feature, unless it is different to the value of SOUACC encoded on the covering **QualityOfData** feature.

6.2.5 Technique of sounding measurement

If it is required to encode the technique of sounding measurement, it must be done using the attribute TECSOU on either the meta feature **QualityOfData** or on individual geo features (e.g. **Sounding**).

The technique of sounding measurement must not be encoded using TECSOU on the depth geo feature, unless it is different to the value of TECSOU encoded on the covering **AccuracyOfPosition** feature.

6.3 Accuracy of non-bathymetric data

6.3.1 Quality of positions

The meta feature **AccuracyOfPosition** may be used to provide an overall accuracy of position for all non-bathymetric features. It must not be used to provide the accuracy of bathymetric information.

The attributes QUAPOS and POSACC may be applied to any spatial feature, in order to qualify the location of a feature.

QUAPOS and POSACC must not be applied to the referenced spatial feature of any geo feature if they are identical to the QUAPOS and POSACC values of the underlying meta feature.

QUAPOS gives qualitative information, whereas POSACC gives quantitative information. POSACC on the **AccuracyOfPosition** applies to non bathymetric data situated within the area, while QUAPOS or POSACC on the associated spatial features, qualifies the location of the **AccuracyOfPosition** feature itself. Meta features **AccuracyOfPosition** and **QualityOfData** should not overlap.

6.3.2 Horizontal accuracy

If it is required to encode the accuracy of a horizontal clearance (attribute HORCLR), it must be done using the attribute HORACC.

HORACC applies only to HORCLR. There is no attribute to express the accuracy of the attributes HORLEN and HORWID.

6.3.3 Vertical accuracy

If it is required to encode the accuracy of a vertical clearance (attributes VERCLR, VERCOP, VERCSA, VERCCL), it must be done using the attribute VERACC.

If several vertical clearances are given for one feature, the accuracy given must be that of the least accurate.

6.3.4 Source of bathymetric data

Details of the source surveys used in compilation may be encoded using the meta feature **SurveyReliability**.

6.3.5 Source of other data

The source of non-bathymetric information should be encoded using both the attributes SORIND and SORDAT on the individual features, but only if this information is considered to be useful to the mariner.

7 Data Capture and Classification

7.1 Introduction

The S-101 Data Capture and Classification guide (DCCG) will provide the information to map real world features into the data set. This Guide is located in Appendix A. Data collected as S-101 shall conform to the Data Classification and Capture Guide.

8 Data Maintenance

Maintenance and Update Frequency:

Data is 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 in the appropriate metadata field.

Production Process:

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

9 Portrayal

9.1 Introduction

S-101 shall include a 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.

Comment [YUN8]: Need phase in dates or approach for new catalogue delivery.

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

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.

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)

10.1.1 Encoding of Latitude and Longitude (S-57 PS 4.4)

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 (10^7) for all datasets.

EXAMPLE A longitude = 42.0000 is converted into X = longitude * CMFX = 42.0000 * 10000000 = 42000000.

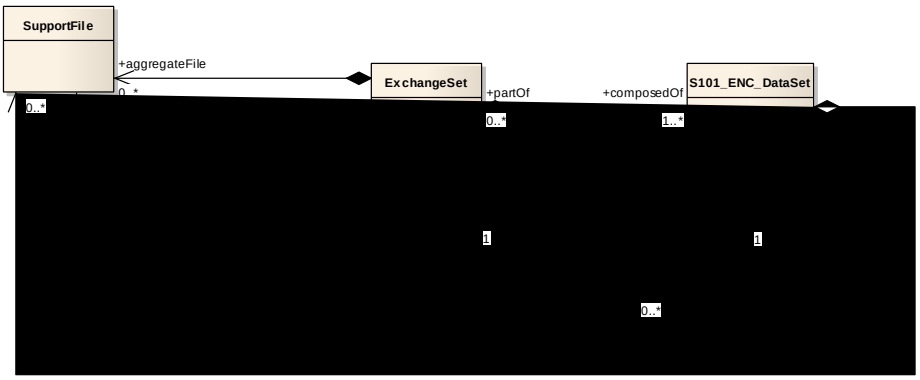
10.1.2 Encoding of Depths (S-57 PS 4.4)

Depths are converted from decimal meters to integers by means of the CMFZ. This product limits the resolution to one decimal place and therefore the CMFZ must be set to 10.

11 Data Product Delivery (S-57 PS 5.8? and 2.2)

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.



11.2 Exchange Set

An exchange set is a grouping of data sets in a logical, consistent and self-contained collection to support the interchange of geospatial data and meta data. It is comprised of at least one cell (i.e a collection of features) and one exchange catalogue. This is the minimum number of entities that can be encapsulated in an exchange set. An exchange set may also contain any number of support files.

Units of Delivery: Exchange Set

Transfer Size: Unlimited

Medium Name: Digital data delivery

Other Delivery Information:

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

– these are files of supplementary information which are linked to by the TXTDSC/PICREP (?) fields within the cells.

An exchange set is encapsulated into a form suitable for transmission either on hard or soft media 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.

This product specification defines a single example encoding for ENC exchange sets which is described in the next section. This encoding provides a hard-media / file based encoding for an exchange set with no encrypted or compressed contents and an additional file based cyclic

redundancy check. It is not intended that this encoding is used for commercial distribution of ENC data as it contains no copy protection mechanisms or data authentication means. A complete encoding suitable for commercial distribution will be published in IHO XX-YY..

With all encodings it is paramount that data is only transformed and not changed. The acid test for an encodings consistency is the ability to extract individual feature information and recalculation of the features CRC value as defined in this standard. If an encoding can replicate the features CRC for arbitrary ENC data then the data has only been transformed (i.e reformatted) and not changed.

The S-101 Product Specification defines an encoding which can be used as a default for transmission of data between parties.

The encoding encapsulates exchange set elements as follows:

- ENC datasets – ISO 8211 encoding of features/attributes and their associated geometry and metadata. Defined further in XXXX
- Exchange Catalogue – the XML encoded representation of exchange set catalogue features [discovery metadata]. Includes an additional file level CRC check per dataset.
- Useful information about the ENC dataset. This is contained within a README.TXT file.
- Supplementary files – These are contained within the exchange set as files and the map from the name included within the cell and the physical location on the media is defined within the Exchange Catalogue.

11.3 Dataset

11.3.1 Data Sets (S-57 PS 5.5)

Two kinds of ENC data set may be produced and contained within an exchange set:

- Update: Changing some information in an existing data set.
- 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 has previously been produced for this area and at the same optimum display scale

Datasets shall not exceed 10MB.

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.

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

When a feature extends across data sets at the same optimum 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 optimum 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.

Data Sets within the same spatial resolution (Optimum Display Scale) may overlap. However, data within the data set must not overlap. Therefore, in the area of overlap only one data set may contain data, all other cells must have a meta feature Data**Coverage** with categoryOfCoverage = 2 covering the overlap area. This rule applies even if several producers are involved.

Data Sets may cross the 180° meridian.

11.3.2 Dataset file naming (S-57 PS 5.6.1)

README file
README.TXT is the mandatory name for this file.

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

CCXXXXXXXX.EEE

The main part forms an identifier where:

- the first two characters identify the issuing agency.
- the third to tenth characters can be used in any way by the producer to provide the unique file name. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).
- .EEE – new editions use 100, updates start at 101 and increment until a limit of 142.

11.3.3 New Editions and Updates(S-57 PS 5.7)

This section describes how S-101 defines updating methodologies for ENC datasets. In order to ensure that feature type updates are incorporated into an ECDIS in the correct sequence without any omission, a number of parameters encoded in the data are used in the following way:

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

update number update number 0 is assigned to a new data set. The first update cell 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. In the case of an update cell file the file extension is the same as the update number. Updates are limited to 42.

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

issue date date up to which the data producer has incorporated all applicable changes.

In order to cancel a data set, an update cell file is created for which the edition number must be set to 0. This message is only used to cancel a base cell file. Where a cell 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 cell.

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.

An exchange set may contain base cell files and update cell files for the same cells. Under these circumstances the update cell files must follow on in the correct sequential order from the last update applied to the base cell 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	TIF	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:

CCXXXXXXXX.EEE

The main part forms an identifier where:

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

11.4.2 Support File Management

Placeholder until this gets fleshed out.

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 (S-57 PS 5.9)

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 Implementation

The checksums for each data set are held in the "CRC" [CRCS] subfield of the "Catalogue Directory" [CATD] field. They allow the integrity of each file in the exchange set to be checked on receipt. The CRC value computed on the received file must the same as the CRC value transmitted.

The CRC values are recorded in ASCII as a hexadecimal number.

11.6.3 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.

12 Metadata

12.1 Introduction

This clause defines the mandatory and optional metadata needed for S-101.

12.1.1 Exchange Set Metadata

Comment [P9]: To be determined

12.1.2 Dataset Metadata

Name	Cardinality	Value	Type	Remarks
DataSetDiscoveryMeta data	-		-	-

Name	Cardinality	Value	Type	Remarks
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.
dataProtection	1	{1} to {2}	CharacterString	1. Encrypted 2. Unprotected
purpose	1	{1} to {4}	CharacterString	1. New Dataset 2. New Edition 3. Update 4.Cancellation
specificUsage	1	{1} to {3}	CharacterString	1.Port Entry 2. Transit 3. Overview
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
updateNumber	1		CharacterString	Update number 0 is assigned to a new data set.
issueDate	1		Date	
productSpecification	1	S-101 version 0.0.1	S-100_ ProductSpecification	This must be encoded as S-101
producingAgency	1		CI_ResponsibleParty	
optimumDisplayScale	1	{1} to {13}	double	Display scale must be one of the 13 predefined scales detailed in Table 1.
horizontalDatum	1	WGS84	CharacterString	
verticalDatum	1		CharacterString	
soundingDatum	1		CharacterString	
dataType	1	ISO 8211 BINARY	S-100_DataFormat	
otherDataTypeDescription	0..1		CharacterString	
boundingBox	1		EX_GeographicBoundingBox	
boundingPolygon	1..*		EX_BoundingPolygon	
comment	0..1		CharacterString	

Comment [P10]: Need definitions.

Comment [YUN11]: S-100 needs to be changed

Name	Cardinality	Value	Type	Remarks
cyclicRedundancyCheck	1		CharacterString NonNegativeInteger	
layerId	1..*	{1} to {3}	integer	Identifies the relationship to other layers that are required to view the complete data set. 1. Scale Independent 2. Scale Dependent 3. Complete

Comment [YUN12]: SI and SD

12.1.3 Support File Metadata

Name	Cardinality	Type	Value	Remarks
S-101 SupportFileDiscoveryMetadata	-	-		-
fileName	1	CharacterString		
filePath	1	CharacterString		
Purpose	1	S-100_SupportFilePurpose	1. New 2. Replacement 3. deletion	Signifies a new file Signifies a replacement of a file with the same name Signifies a deletion of a file of that name
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		
productSpecification	1	S-100_ProductSpecification		
dataType	1	S-100_SupportFileFormat	TXT XML HTM TIFF	Text files Text files Text files Picture files
Comment	0..1	CharacterString		
Crc	1	CharacterString		

Comment [T13]: This should be changed to version number.

Comment [T14]: Need to update S-100 to allow for these new file types.

Comment [JLP15]: Is this correct?

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	Cardinality	Value	Type	Remarks
metadataFileIdentifier	1		CharacterString	Should this be changed from a mandatory in S-100 part 3
metadataPointOfContact	1		CI_ResponsibleParty	
metadataDateStamp	1		Date	
metadataLanguage	1	English	CharacterString	All data sets conforming to S-101 PS must use English language
name	1		CharacterString	

Name	Cardinality	Value	Type	Remarks
path			CharacterString	
abstract	1		CharacterString	E.g. a harbour or port name, between two named locations etc.
productSpecificationEditionNumber	1			
comment	0..1		CharacterString	
compressionFlag	1	{1} to {2}	CharacterString	1. Yes 2. No
algorithmMethod	1		CharacterString	ZIP, RAR, etc.
sourceMedia	1			
replacedData	1			If a data file is cancelled is it replaced by another data file
dataReplacement				Cell name

Comment [YUN16]: Find source – RC and everything below

Comment [YUN17]: Find source of this info – RC?

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.

All national language attributes must be encoded in the “National Attribute” [NATF] field.

12.2.1 Use of lexical level 2

Comment [JLP18]: ACTION: Holger to provide verbiage --- How are dealing with this for Phase one since lexical level is no longer valid?

If the national language cannot be expressed in lexical levels 0 or 1, the following rules apply:

- the exact spelling in the national language is encoded in the “National Attribute” [NATF] field using lexical level 2.
- translated text, including transliterated or transcribed national geographic names, is encoded in the “International Attributes” [ATTF] field using lexical level 0 or 1.

Where possible international standards should be used for the transliteration of non-Latin alphabets.

ANNEX A

Data Product format (encoding) (S-57 PS 6)

A1 Introduction

A1.1 Data set files

The order of data in each base or update cell 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 (ordered from slave to master)
- 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).

A1.2 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.

A1.3 Fields

For base cell files, some fields may be repeated (indicated by <R>) 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.

A1.4 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 clause ???

Comment [j19]: At present, it is intended that this go in the DCCG, therefore this reference should be to Appendix A.

In the tables following the tree structure diagrams, mandatory subfields are shown by “M” in the “use” column and prohibited subfields by “P” in the same column. If there is nothing in this column, it means that the use of this subfield is optional. When a subfield value is prescribed, it is indicated in the “value” column. The “comment” column contains general comments and an indication of whether the subfield is ASCII or binary coded.

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

A1.5 Base cell structure

Base cell file

```
|
|--<1>--Data Set General Information record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--DSID - Data Set Identification field
|                        |
|                        |--<1>--DSSI - Data Set Structure Information field
|                        |
|                        |--<R>-- ATTR – Attribute Field (Metadata)
|
|--<1>--Data Set Coordinate Reference System record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--CRID - Coordinate Reference System Record Identifier field
|                        |
|                        |--<1..2>--CRSH - Coordinate Reference System Header field
|                        |
|                        |--<1>--CSAX - Coordinate System Axes field
|                        |
|                        |--<1>-- PROJ - Projection field
|                        |
|                        *--GDAT - Geodetic Datum field
|                        |
|                        *--<R>--VDAT - Vertical Datum field

|--<R>--Information record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<R>-- ATTR – Attribute field
|                        |
|                        |--<R>-- INAS – Information Association field
|
|--<R>-- Point record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--PRID – Point Record Identifier field
|                        |
|                        |--<R>--ATTR - Attribute field
|                        |
|                        |--<R>--INAS - Vector Record Pointer field
|                        |
|                        | alternate coordinate representations
|                        |
```

```
|                       *--C2DI (2): 2-D Integer Coordinate field
|                       |
|                       *--C3DI (4): 3-D Integer Coordinate field
|                       |
|                       *--C2DF (2): 2-D Floating Point Coordinate field
|                       |
|                       *--C3DF (4): 3-D Floating Point Coordinate field
|
|--<R>--Multi Point record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--MRID - Multi Point Record Identifier field
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--<1>--COCC - Coordinate Control field
|                       |
|                       *--<R>--C2DI - 2-D Integer Coordinate field
|                       |
|                       *--<R>--C3DI - 3-D Integer Coordinate field
|                       |
|                       *--<R>--C2DF - 2-D Floating Point Coordinate field
|                       |
|                       *--<R>--C3DF - 3-D Floating Point Coordinate field
|
|--<R>-- Curve record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--CRID - Curve Record Identifier field
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--PTAS – Point Association field
|                       |
|                       |--SECC – Segment Header field
|                       |
|                       |--COCC - Coordinate Control field
|                       |
|                       | alternate coordinate representation
|                       |
|                       *--<R>--C2DI - 2-D Integer Coordinate field
|                       |
|                       *--<R>--C3DI - 3-D Integer Coordinate field
|                       |
|                       *--<R>--C2DF - 2-D Floating Point Coordinate field
|                       |
|                       *--<R>--C3DF - 3-D Floating Point Coordinate field
|
|--<R>-- Composite Curve record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--CCID – Composite Curve Record Identifier field
```

```
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--CCOC – Curve Component Control field
|                       |
|                       |--<R>--CUCO – Curve Component field
|
|--<R>-- Surface record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--SRID – Surface Record Identifier field
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--<R>--RIAS – Ring Association Field'
|
|--<R>-- Feature Type record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--FRID - Feature Type Record Identifier field
|                       |
|                       |--FOID - Feature Object Identifier field
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--<R>--SPAS - Spatial Association field
|                       |
|                       |--<R>--FEAS - Feature Association field
|                       |
|                       |--<R>--THAS - Theme Association field
|                       |
|                       |-<R>-MASK (*3): Masked Spatial Type field
```

Field Content

A1.5.1 Data Set Identification field structure

Field Tag: **DSID**	Field Name: Data Set Identification

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		b11	{10} - Data Set Identification
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Encoding specification	ENSP		A()	Encoding specification that defines the encoding
Encoding specification edition	ENED		A()	Edition of the encoding specification

Product identifier	PRSP		A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED		A()	Edition of the product specification
Application profile	PROF		A()	Identifier that specifies a profile within the data product
Dataset file identifier	DSNM		A()	The file identifier of the dataset
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG		A()	The (primary) language used in this dataset
Dataset abstract	DSAB		A()	The abstract of the dataset
Dataset edition	DSED		A()	The edition of the dataset
Dataset topic category	*DSTC		b11	A set of topic categories

Data Descriptive Field

```
3600;&%/GData□Set□Identification▲RCNM!RCID!STRD!ENED!PRSP!PRED!PROF!DSNM
!DSTL!DSRD!DSLG!DSAB!DSED\\*DSTC▲(b11,b14,7A,A(8),3A,b11)▼
```

A1.5.2 Data Set Structure Information field structure

Field Tag: **DSSI**	Field Name: Data Set Structure Information

Subfield name	Label	Value	Format	Subfield content and specification
Dataset Coordinate Origin X	DCOX		b48	Shift used to adjust x-coordinate before encoding
Dataset Coordinate Origin Y	DCOY		b48	Shift used to adjust y-coordinate before encoding
Dataset Coordinate Origin Z	DCOZ		b48	Shift used to adjust z-coordinate before encoding
Coordinate multiplication factor for x-coordinate	CMFX		b14	Floating point to integer multiplication factor for the x-coordinate or longitude
Coordinate multiplication factor for y-coordinate	CMFY		b14	Floating point to integer multiplication factor for the y-coordinate or latitude
Coordinate multiplication factor for z-coordinate	CMFZ		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

Data Descriptive Field

```
1600;&□□□Data□Set□Structure□Information▲DCOX!DCOY!DCOZ!CMFX!CMFY!CMFZ!NO
IR!NOPM!NOMN!NOCN!NOXN!NOSN!NOFR▲(3b48,10b14)▼
```

A1.5.3 Attribute field structure

Field Tag: **ATTR**	Field Name: Attribute

Subfield name	Label	Value	Format	Subfield content and specification
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.

Data Descriptive Field

```
2600;&%/GAttribute▲*ATLB!ATIX!PAIX!ATIN!ATVL▲(3b12,b11,A)▼
```

A1.5.4 Data Set Coordinate Reference System record structure

A1.5.4.1 Coordinate Reference System Record Identifier field structure

Field Tag: **CRID**	Field Name: Coordinate Reference System Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		b11	{15} - Coordinate Reference System Identifier
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Number of CRS Components	NCRC		b11	{1} - Single CRS {2} - Compound CRS (2 components)

Data Descriptive Field

```
1100;&□□□Coordinate□Reference□System□Record□Identifier▲RCNM!RCID!NCRC▲(b
11,b14,b11)▼
```

A1.5.4.2 Coordinate Reference System Header field structure

Field Tag: **CRSH**	Field Name: Coordinate Reference System Header

Subfield name	Label	Value	Format	Subfield content and specification
CRS Type	CRST		b11	see table
Coordinate System Type	CSTY		b11	{1} - Ellipsoidal CS {2} - Cartesian CS {3} - Vertical CS
CRS Name	CRNM		A()	Name of the Coordinate Reference System
CRS Identifier	CRSI		A()	Identifier of the CRS from an external source. Empty if not defined by reference
CRS Source	CRSS		b11	{1} - IHO CRS Register {2} - EPSG {254} - Other Source {255} - Not Applicable
CRS Source Information	SCRI		A()	Information about the CRS source if CRSS = 'Other Source'

Comment [j20]: This seems out of place in the CRS header field. A coordinate system structure is needed. Some means of identifying which CS definition belongs to a CRS definition is needed. The coordinate system structure needs to list its axis(es) in order. This order is important because it defines the meaning of coordinate values in a tuple – the values follow the same order as the axis(es) – at least this is the ISO 19111 approach.

Data Descriptive Field

```
1600;&%/GCoordinate□Reference□System□Header▲CRST!CSTY!CRNM!CRSI!CRSS!SRC
I▲(2b11,2A,b11,A)▼
```

A1.5.4.3 Coordinate System Axes field structure

Comment [j21]: Missing axis orientation (eg up, down, east, west etc)

Field Tag: **CSAX**	Field Name: Coordinate System Axes

Subfield name	Label	Value	Format	Subfield content and specification
Axis Type	*AXTY		b11	see table
Axis Unit of Measure	AXUM		b11	{1} - Degree {2} - Grad {3} - Radian {4} - Metre {5} - International foot {6} - US survey foot

Comment [j22]: What is meant by axis type?

Data Descriptive Field

```
2100;&□□□Coordinate□System□Axes▲*AXTY!AXUM▲(2b11)▼
```

A1.5.4.4 Projection field structure

Comment [j23]: Section 11.5 outlaws projections

Field Tag: **PROJ**	Field Name: Projection

Subfield name	Label	Value	Format	Subfield content and specification
Projection Method	PROM		b11	see table
Projection Parameter 1	PRP1		b48	see table
Projection Parameter 2	PRP2		b48	see table
Projection Parameter 3	PRP3		b48	see table

Projection Parameter 4	PRP4		b48	see table
Projection Parameter 5	PRO5		b48	see table
False Easting	FEAS		b48	False easting (Units of measurement according to the coordinate axis 'Easting'
False Northing	FNOR		b48	False northing (Units of measurement according to the coordinate axis 'Northing'

Comment [j24]: Why are False Easting and False Northing defined explicitly in addition to the projection parameters? They are themselves projection parameters.

Data Descriptive Field

```
1600;&□□□Projection▲PROM!PRP1!PRP2!PRP3!PRP4!PRP5!FEAS!FNOR!▲(b11,7b48)▼
```

A1.5.4.5 Geodetic Datum field structure

Field Tag: **GDAT**	Field Name: Geodetic Datum

Subfield name	Label	Value	Format	Subfield content and specification
Datum Name	DTNM		A()	Name of the geodetic datum
Ellipsoid Name	ELNM		A()	Name of the ellipsoid
Ellipsoid semi major axis	ESMA		b48	Semi major axis of the ellipsoid in metre
Ellipsoid second parameter type	ESPT		b11	{1} - Semi minor axis in metres {2} - Inverse Flattening
Ellipsoid second parameter	ESPM		b48	The second defining parameter of the ellipsoid
Central Meridian Name	CMNM		A()	Name of the central meridian
Central Meridian Greenwich Longitude	CMGL		b48	Greenwich longitude of the central meridian in degrees

Comment [j25]: Length of the semi-major axis of the ellipsoid [ISO 19111]

Comment [j26]: ISO 19111 also includes isSphere (Boolean) in the list of second defining parameters. If isSphere = true then a value for the second defining parameter is not needed since the sphere is defined by its radius which is specified by the Semi Major Axis.

Comment [j27]: The value of the second defining parameter (Scale if Inverse Flattening, Length if Semi Minor Axis)

Comment [j28]: Prefer the term Prime Meridian instead of central meridian in this context.

Comment [j29]: Longitude of the prime meridian measured from the Greenwich Meridian, positive eastward [ISO 19111]

Data Descriptive Field

```
1600;&%/GGeodetic□Datum▲DTNM!ELNM!ESMA!ESPT!ESPM!CMNM!CMGL!▲(2A,b48,b11,
b48,A,b48)▼
```

A1.5.4.6 Vertical Datum field structure

Field Tag: **VDAT**	Field Name: Vertical Datum

Subfield name	Label	Value	Format	Subfield content and specification
Datum Index	DTIX		b11	Internal identifier of the Vertical Datum
Datum Name	DTNM		A()	Name of the Vertical datum
Datum Identifier	DTID		A()	Identifier of the datum in an external source
Datum Source	DTSR		b11	{1} - IHO CRS Register {2} - Feature Catalogue {3} - EPSG {254} - Other Source {255} - Not Applicable
Datum Source Information	SCRI		A()	Information about the CRS source if DTSR = 'Other Source'

Data Descriptive Field

```
1600;&%/GVertical□Datum▲DTIX!DTNM!DTID!DTSR!SCRI!▲(b11,2A,b11,A)▼
```

A1.5.5 Information Type Identifier field structure

Field Tag: **IRID**	Field Name: Information Type Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		b11	{150} - Information Type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Object code	OBJC		b12	A valid object code
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN		b11	{1} - Insert {2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Information□Type□Record□Identifier▲RCNM!RCID!OBJC!RVER!RUIN▲(b1
1,b14,2b12,b11)▼
```

A1.5.6 Coordinate Control field structure

Field Tag: **COCC** [Upd]	Field Name: Coordinate Control

Subfield name	Label	Value	Format	Subfield content and specification
Coordinate Update Instruction	COUI		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

Data Descriptive Field

```
1100;&□□□Coordinate□Control▲COUI!COIX!NCOR▲(b11,2b12)▼
```

A1.5.7 2-D Integer Coordinate field structure

Field Tag: **C2DI**	Field Name 2-D Integer Coordinate

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

Data Descriptive Field

```
2100;&□□□2-D□Integer□Coordinate▲*YCOO!XCOO▲(2b24)▼
```

A1.5.8 3-D Integer Coordinate field structure

Field Tag: **C3DI**	Field Name: 3-DInteger Coordinate

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

Data Descriptive Field

```
3100;&□□□3-D□Integer□Coordinate▲VDID\\*YCOO!XCOO!ZCOO▲(b11,3b24)▼
```

A1.5.8.1 Point Record Identifier field structure

Field Tag: **PRID**	Field Name: Point Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		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		b11	{1} - Insert {2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Point□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b11)▼
```

A1.5.8.2 Multi Point Record Identifier field structure

Field Tag: **MRID**	Field Name: Multi Point Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		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		b11	{1} - Insert {2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Multi□Point□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b
11)▼
```

A1.5.8.3 Curve Record Identifier field structure

Field Tag: **CRID**	Field Name: Curve Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		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		b11	{1} - Insert {2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Curve□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b11)▼
```

A1.5.8.4 Point Association field structure

Field Tag: **PTAS**	Field Name: Point 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
Topology indicator	TOPI		b11	{1} - Beginning point {2} - End point {3} - Beginning & End point

Data Descriptive Field

```
2100;&□□□Point□Association▲*RRNM!RRID!TOPI▲(b11,b14,b11)▼
```

A1.5.8.5 Segment Control field structure

Field Tag: **SECC** [Upd]	Field Name: Segment Control

Subfield name	Label	Value	Format	Subfield content and specification
Segment update instruction	SEUI		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

Data Descriptive Field

```
1100;&□□□Segment□Control▲SEUI!SEIX!NSEG▲(b11,2b12)▼
```

A1.5.8.6 Segment Header field structure

Field Tag: **SEGH**	Field Name: Segment Header

Subfield name	Label	Value	Format	Subfield content and specification
Interpolation	INTP		b11	{1} - Linear {2} - Arc3Points {3} - Geodetic {4} - Loxodromic

Data Descriptive Field

```
1100;&□□□Segment□Header▲INTP▲(b11)▼
```

A1.5.8.7 Composite Curve Record Identifier field structure

Field Tag: **CCID**	Field Name: Composite Curve Record Identifier

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

Data Descriptive Field

```
1100;&□□□Composite□Curve□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,
b12,b11)▼
```

A1.5.8.8 Curve Component Control field structure

Field Tag: **CRPC** [Upd]	Field Name: Curve Component Control

Subfield name	Label	Value	Format	Subfield content and specification
Curve Component update instruction	CCUI		b11	{1} - Insert {2} - Delete {3} - Modify
Curve Component index	CCIX		b12	Index (position) of the addressed Curve record pointer within the CRPT field(s) of the target record
Number of Curve Components	NCCO		b12	Number of Curve record pointer in the CRPT field(s) of the update record

Data Descriptive Field

```
1100;&□□□Curve□Component□Control▲CCUI!CCIX!NCCO▲(b11,2b12)▼
```

A1.5.8.9 Curve Component field structure

Field Tag: **CUCO**	Field Name: Curve Component

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
Orientation	ORNT		b11	{1} - Forward {2} - Reverse

Data Descriptive Field

```
2100;&□□□Curve□Component▲*RRNM!RRID!ORNT▲(b11,b14,b11)▼
```

A1.5.8.10 Surface Record Identifier field structure

Field Tag: **SRID**	Field Name: Surface Record Identifier

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

Data Descriptive Field

```
1100;&□□□Surface□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b11)
▼
```

A1.5.8.11 Ring Association field structure

Field Tag: **RIAS**	Field Name: Ring 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
Orientation	ORNT		b11	{1} - Forward {2} - Reverse
Usage indicator	USAG		b11	{1} - Exterior {2} - Interior

Ring Association update instruction	RAUI		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Ring□Association▲RRNM!RRID!ORNT!USAG!RAUI▲(b11,b14,3b11)▼
```

A1.5.9 Feature Type Record Identifier field structure

Field Tag: **FRID**	Field Name: Feature Type Record Identifier

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

Data Descriptive Field

```
1100;&□□□Feature□Type□Record□Identifier▲RCNM!RCID!OBJC!RVER!RUIN▲(b11,b1
4,2b12,b11)▼
```

A1.5.10 Feature Object Identifier field structure

Field Tag: **FOID**	Field Name: Feature Object Identifier

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

Data Descriptive Field

```
1100;&□□□Feature□Object□Identifier▲AGEN!FIDN!FIDS▲(b12,b14,b12)▼
```

A1.5.11 Spatial Association field structure

Field Tag: **SPAS**	Field Name: Spatial 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
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		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Spatial□Association▲*RRNM!RRID!ORNT!SMIN!SMAX!SAUI!▲(b11,b14,b1
1,2b14,b11)▼
```

A1.5.12 Feature Association field

Field Tag: **FEAS**	Field Name: Feature 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
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		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Feature□Association▲*RRNM!RRID!ASCD!RLCD!APUI▲(b11,b14,2b12,b11
)▼
```

A1.5.13 Theme Association field

Field Tag: **THAS**	Field Name: Theme 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
Theme Association Update Instruction	TAUI		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Theme□Association▲*RRNM!RRID!TAUI▲(b11,b14,b11)▼
```

A1.5.14 Masked Spatial Type field structure

Field Tag: **MASK**	Field Name: Masked Spatial Type

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
Mask Update Instruction	MUIN		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Masked□Spatial□Record▲*RRNM!RRID!MUIN▲(b11,b14,b11)▼
```

A1.6 Update dataset structure

Update Dataset file
- |
- |--<1>--Data Set General Information record
- | |
- | |--0001 - ISO/IEC 8211 Record Identifier
- | |
- | |--<1>--DSID - Data Set Identification field
- | |
- | |--<1>--DSSI - Data Set Structure Information field
- | |
- | |--<R>-- ATTR – Attribute Field (Metadata)
- |
- |--<R>--Information record
- | |
- | |--0001 - ISO/IEC 8211 Record Identifier
- | |
- | |--<R>-- ATTR – Attribute field
- | |
- | |--<R>-- INAS – Information Association field
- |
- |--<R>-- Point record
- | |
- | |--0001 - ISO/IEC 8211 Record Identifier
- | |

```
|          |--<1>--PRID – Point Record Identifier field
|                          |
|                          |--<R>--ATTR - Attribute field
|                          |
|                          |--<R>--INAS - Vector Record Pointer field
|                          |
|                          | alternate coordinate representations
|                          |
|                          *--C2DI (2): 2-D Integer Coordinate field
|                          |
|                          *--C3DI (4): 3-D Integer Coordinate field
|                          |
|                          *--C2DF (2): 2-D Floating Point Coordinate field
|                          |
|                          *--C3DF (4): 3-D Floating Point Coordinate field
|
|--<R>--Multi Point record
|     |
|     |--0001 - ISO/IEC 8211 Record Identifier
|          |
|          |--<1>--MRID - Multi Point Record Identifier field
|                          |
|                          |--<R>--ATTR - Attribute field
|                          |
|                          |--<R>--INAS - Information Association field
|                          |
|                          |--<1>--COCC - Coordinate Control field
|                          |
|                          *--<R>--C2DI - 2-D Integer Coordinate field
|                          |
|                          *--<R>--C3DI - 3-D Integer Coordinate field
|                          |
|                          *--<R>--C2DF - 2-D Floating Point Coordinate field
|                          |
|                          *--<R>--C3DF - 3-D Floating Point Coordinate field
|
|--<R>-- Curve record
|     |
|     |--0001 - ISO/IEC 8211 Record Identifier
|          |
|          |--<1>--CRID - Curve Record Identifier field
|                          |
|                          |--<R>--ATTR - Attribute field
|                          |
|                          |--<R>--INAS - Information Association field
|                          |
|                          |--PTAS – Point Association field
|                          |
|                          |--SECC – Segment Header field
|                          |
|                          |--COCC - Coordinate Control field
|                          |
|                          | alternate coordinate representation
|                          |
|                          *--<R>--C2DI - 2-D Integer Coordinate field
|                          |
|                          *--<R>--C3DI - 3-D Integer Coordinate field
|                          |
|                          *--<R>--C2DF - 2-D Floating Point Coordinate field
```

```
|                       |
|                       *--<R>--C3DF - 3-D Floating Point Coordinate field
|
|--<R>-- Composite Curve record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--CCID – Composite Curve Record Identifier field
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--CCOC – Curve Component Control field
|                       |
|                       |--<R>--CUCO – Curve Component field
|
|--<R>-- Surface record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--SRID – Surface Record Identifier field
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--<R>--RIAS – Ring Association Field'
|
|--<R>-- Feature Type record
|    |
|    |--0001 - ISO/IEC 8211 Record Identifier
|         |
|         |--<1>--FRID - Feature Type Record Identifier field
|                       |
|                       |--FOID - Feature Object Identifier field
|                       |
|                       |--<R>--ATTR - Attribute field
|                       |
|                       |--<R>--INAS - Information Association field
|                       |
|                       |--<R>--SPAS - Spatial Association field
|                       |
|                       |--<R>--FEAS - Feature Association field
|                       |
|                       |--<R>--THAS - Theme Association field
|                       |
|                       |-<R>-MASK (*3): Masked Spatial Type field
```

Field Content

A1.6.1 Data Set Identification field structure

Field Tag: **DSID**	Field Name: Data Set Identification

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		b11	{10} - Data Set Identification
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Encoding specification	ENSP		A()	Encoding specification that defines the encoding
Encoding specification edition	ENED		A()	Edition of the encoding specification
Product identifier	PRSP		A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED		A()	Edition of the product specification
Application profile	PROF		A()	Identifier that specifies a profile within the data product
Dataset file identifier	DSNM		A()	The file identifier of the dataset
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG		A()	The (primary) language used in this dataset
Dataset abstract	DSAB		A()	The abstract of the dataset
Dataset edition	DSED		A()	The edition of the dataset
Dataset topic category	*DSTC		b11	A set of topic categories

Data Descriptive Field

```
3600;&%/GData□Set□Identification▲RCNM!RCID!STRD!ENED!PRSP!PRED!PROF!DSNM
!DSTL!DSRD!DSLG!DSAB!DSED\\*DSTC▲(b11,b14,7A,A(8),3A,b11)▼
```

A1.6.2 Data Set Structure Information field structure

Field Tag: **DSSI**	Field Name: Data Set Structure Information

Subfield name	Label	Value	Format	Subfield content and specification
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

Data Descriptive Field

```
1600;&□□□Data□Set□Structure□Information▲DCOX!DCOY!DCOZ!CMFX!CMFY!CMFZ!NO
IR!NOPM!NOMN!NOCN!NOXN!NOSN!NOFR▲(3b48,10b14)▼
```

A1.6.3 Attribute field structure

Field Tag: **ATTR**	Field Name: Attribute

Subfield name	Label	Value	Format	Subfield content and specification
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.

Data Descriptive Field

```
2600;&%/GAttribute▲*ATLB!ATIX!PAIX!ATIN!ATVL▲(3b12,b11,A)▼
```

A1.6.4 Information Type Identifier field structure

Field Tag: **IRID**	Field Name: Information Type Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		b11	{150} - Information Type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Object code	OBJC		b12	A valid object code
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN		b11	{1} - Insert {2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Information□Type□Record□Identifier▲RCNM!RCID!OBJC!RVER!RUIN▲(b1
1,b14,2b12,b11)▼
```

A1.6.5 Coordinate Control field structure

Field Tag: **COCC** [Upd]	Field Name: Coordinate Control

Subfield name	Label	Value	Format	Subfield content and specification
Coordinate Update Instruction	COUI		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

Data Descriptive Field

```
1100;&□□□Coordinate□Control▲COUI!COIX!NCOR▲(b11,2b12)▼
```

A1.6.6 2-D Integer Coordinate field structure

Field Tag: **C2DI**	Field Name 2-D Integer Coordinate

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

Data Descriptive Field

```
2100;&□□□2-D□Integer□Coordinate▲*YCOO!XCOO▲(2b24)▼
```

A1.6.7 3-D Integer Coordinate field structure

Field Tag: **C3DI**	Field Name: 3-DInteger Coordinate

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

Data Descriptive Field

```
3100;&□□□3-D□Integer□Coordinate▲VDID\\*YCOO!XCOO!ZCOO▲(b11,3b24)▼
```

A1.6.7.1 Point Record Identifier field structure

Field Tag: **PRID**	Field Name: Point Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		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		b11	{1} - Insert {2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Point□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b11)▼
```

A1.6.7.2 Multi Point Record Identifier field structure

Field Tag: **MRID**	Field Name: Multi Point Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		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		b11	{1} - Insert {2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Multi□Point□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b
11)▼
```

A1.6.7.3 Curve Record Identifier field structure

Field Tag: **CRID**	Field Name: Curve Record Identifier

Subfield name	Label	Value	Format	Subfield content and specification
Record name	RCNM		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		b11	{1} - Insert

				{2} - Delete {3} - Modify

Data Descriptive Field

```
1100;&□□□Curve□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b11)▼
```

A1.6.7.4 Point Association field structure

Field Tag: **PTAS**	Field Name: Point 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
Topology indicator	TOPI		b11	{1} - Beginning point {2} - End point {3} - Beginning & End point

Data Descriptive Field

```
2100;&□□□Point□Association▲*RRNM!RRID!TOPI▲(b11,b14,b11)▼
```

A1.6.7.5 Segment Control field structure

Field Tag: **SECC** [Upd]	Field Name: Segment Control

Subfield name	Label	Value	Format	Subfield content and specification
Segment update instruction	SEUI		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

Data Descriptive Field

```
1100;&□□□Segment□Control▲SEUI!SEIX!NSEG▲(b11,2b12)▼
```

A1.6.7.6 Segment Header field structure

Field Tag: **SEGH**	Field Name: Segment Header

Subfield name	Label	Value	Format	Subfield content and specification
Interpolation	INTP		b11	{1} - Linear {2} - Arc3Points {3} - Geodetic {4} - Loxodromic

Data Descriptive Field

```
1100;&□□□Segment□Header▲INTP▲(b11)▼
```

A1.6.7.7 Composite Curve Record Identifier field structure

Field Tag: **CCID**	Field Name: Composite Curve Record Identifier

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

Data Descriptive Field

```
1100;&□□□Composite□Curve□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,
b12,b11)▼
```

A1.6.7.8 Curve Component Control field structure

Field Tag: **CRPC** [Upd]	Field Name: Curve Component Control

Subfield name	Label	Value	Format	Subfield content and specification
Curve Component update instruction	CCUI		b11	{1} - Insert {2} - Delete {3} - Modify
Curve Component index	CCIX		b12	Index (position) of the addressed Curve record pointer within the CRPT field(s) of the target record
Number of Curve Components	NCCO		b12	Number of Curve record pointer in the CRPT field(s) of the update record

Data Descriptive Field

```
1100;&□□□Curve□Component□Control▲CCUI!CCIX!NCCO▲(b11,2b12)▼
```

A1.6.7.9 Curve Component field structure

Field Tag: **CUCO**	Field Name: Curve Component

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
Orientation	ORNT		b11	{1} - Forward {2} - Reverse

Data Descriptive Field

```
2100;&□□□Curve□Component▲*RRNM!RRID!ORNT▲(b11,b14,b11)▼
```

A1.6.7.10 Surface Record Identifier field structure

Field Tag: **SRID**	Field Name: Surface Record Identifier

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

Data Descriptive Field

```
1100;&□□□Surface□Record□Identifier▲RCNM!RCID!RVER!RUIN▲(b11,b14,b12,b11)
▼
```

A1.6.7.11 Ring Association field structure

Field Tag: **RIAS**	Field Name: Ring 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
Orientation	ORNT		b11	{1} - Forward {2} - Reverse
Usage indicator	USAG		b11	{1} - Exterior {2} - Interior
Ring Association update instruction	RAUI		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Ring□Association▲RRNM!RRID!ORNT!USAG!RAUI▲(b11,b14,3b11)▼
```

A1.6.8 Feature Type Record Identifier field structure

Field Tag: **FRID**	Field Name: Feature Type Record Identifier

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

Data Descriptive Field

```
1100;&□□□Feature□Type□Record□Identifier▲RCNM!RCID!OBJC!RVER!RUIN▲(b11,b1
4,2b12,b11)▼
```

A1.6.9 Feature Object Identifier field structure

Field Tag: **FOID**	Field Name: Feature Object Identifier

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

Data Descriptive Field

```
1100;&□□□Feature□Object□Identifier▲AGEN!FIDN!FIDS▲(b12,b14,b12)▼
```

A1.6.10 Spatial Association field structure

Field Tag: **SPAS**	Field Name: Spatial 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
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		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Spatial□Association▲*RRNM!RRID!ORNT!SMIN!SMAX!SAUI!▲(b11,b14,b1
1,2b14,b11)▼
```

A1.6.11 Feature Association field

Field Tag: **FEAS**	Field Name: Feature 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
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		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Feature□Association▲*RRNM!RRID!ASCD!RLCD!APUI▲(b11,b14,2b12,b11
)▼
```

A1.6.12 Theme Association field

Field Tag: **THAS**	Field Name: Theme 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
Theme Association Update Instruction	TAUI		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Theme□Association▲*RRNM!RRID!TAUI▲(b11,b14,b11)▼
```

A1.6.13 Masked Spatial Type field structure

Field Tag: **MASK**	Field Name: Masked Spatial Type

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
Mask Update Instruction	MUIN		b11	{1} - Insert {2} - Delete

Data Descriptive Field

```
2100;&□□□Masked□Spatial□Record▲*RRNM!RRID!MUIN▲(b11,b14,b11)▼
```

ANNEX B (informative)

S-101 Maintenance - Change Proposal Form

Organisation		Date	
Contact		Email	

Change Proposal Type *Select only one option*

1.Clarification	2.Correction	3.Extension

Location *Identify all change proposal locations*

S-100 Version No.	Part No.	Section No.	Proposal Summary

Change Proposal

Please provide a detailed change proposal.

Change Proposal Justification

Please provide a suitable explanation for the change and where applicable supporting documentation.

Please send completed forms and supporting documentation to Thomas.Mellor@ukho.gov.uk.

Notes on ISO 8211 by Jonathan Prichard.

I have been thinking about iso8211 and ENC encodings in the context of S-101 for some time. We have been discussing the benefits of multiple encodings and the possibility of reconciling our integrity checks using a canonical form but this has led to a general discussion on the merits (or otherwise) of iso8211 encoding for ENC. iso8211 has been used ever since ENC was invented and is still the bottom layer of encoding within an ENC, i.e the data structures and records are encoded using iso8211's binary format. But how efficient is that format. Since the ENC cell is immutably associated with the file that contains the encoding it's where you should have the least "slack". The encoding of the ENC data has to be transferred via hard media or online transmission to every single customer so any inefficiencies which exist in the way the data is encoded are multiplied massively. I undertook a short survey on the amount of data compared with the amount of non-data within an ENC and the results are presented below:

Iso8211 structure.

The header.
Let's take a look at a typical ENC cell. It is a binary encoding of the ENC. iso8211 is a self describing binary format which uses a header/body structure to deliver its contents. Within a single iso8211 file there is a variable length header which describes all the records within the rest of the file and also their structure. Each record is made up of a number of subfields, each of which has a particular binary representation.

Data records
The header is then followed by a sequence of records. Each record follows the same structure.

1. A 5-byte length indicator for the entire record

2. A 24 byte leader which contains flags about how the record is constructed including an offset to the first byte of data.

3. A catalogue which describes each subfield, its length and offset (from the iso8211 header the reader knows then what sequence the data is in)

4. The data itself. Each record is standalone and contains no CRC values, record counts or other information. The structure of each record is laid down in the Se57 edition 3.1 ENC product specification. So, for example if we look at a simplified ENC update (I have used an update to illustrate the points made as it is a smaller file. A new edition is somewhat larger as we will see...).

Length Offset Name/Length
1. 01894 HEADER
2. 00301 00067 0001 00003 DSID 00195 DSSI 00036
3. 00069 00053 0001 00003 FRID 00013
4. 00069 00053 0001 00003 FRID 00013
5. 00069 00053 0001 00003 FRID 00013
6. 00069 00053 0001 00003 FRID 00013
7. 00069 00053 0001 00003 FRID 00013
8. 00181 00095 0001 00003 FRID 00013 FOID 00009 ATTF 00052 FSPT 00009
9. 00180 00095 0001 00003 FRID 00013 FOID 00009 ATTF 00051 FSPT 00009
10. 00177 00095 0001 00003 FRID 00013 FOID 00009 ATTF 00048 FSPT 00009
11. 00179 00095 0001 00003 FRID 00013 FOID 00009 ATTF 00050 FSPT 00009
12. 00230 00109 0001 00003 FRID 00013 FOID 00009 ATTF 00046 FFPT 00041 FSPT 00009

Finished. 11 records 3482 772

The above table shows a simple ENC update with just the data record and structure left behind. The header is 1894 bytes and then there are 11 data records with varying sizes and data offsets. you can see the update starts with a DSID & DSSI records and then continues with a number of feature related records. What's the point...? The point is the last line where it says "Finished". If you look in record (2) above, the first actual data record you will see that the whole record is 301 bytes long but the data doesn't start until byte 67. This is to allow enough space for the file to encode the DSSI and DSID catalogue entry before describing the data. So there are only 301-67 = 234 bytes of space being used to encode actual data. In fact, over the entire file there are 11 records which make up a file of 3,482 bytes, of which only 772 are used to encode real ENC data. The rest is header (1,894 bytes), record leaders and catalogue descriptors (in fact the "0001" records, of which there are one per record also take up 33 bytes). So, only 22% of the cell contains actual data... The rest is just iso8211 structure.
The point is... iso8211 is very good and very compact at storing data but it works best within a single file. Once you rely on multiple files you duplicate its self-describing overheads.

What does this mean for a base cell?
The example above is an update file. 90% of data which we distribute is actually new editions or new cells. In the case of a base cell the picture is slightly different. The size is not dominated by the 8211 header any more since the cell files are a lot larger. There are a large number of records though and in a lot of these the 8211 overhead of leader + catalogue is much larger than the data which it encompasses. I looked at some GB cells and, sparing the details of the actual records involved, found the following results (I've reproduced just the last line of the output from the previous example:

Cell Name Records Total size Data Size
GB203552.000 269 533152 378010
GB203593.000 1987 327800 214897
GB203596.000 4022 666528 437442

So you can see from the table above that 66-71% of the cell is data, the rest is record overhead!
It would be interesting to see what results could be gleaned from the current world ENC portfolio. I actually had a stab at this and got similar results. Of the 24,424 base and update cells which constituted the last UKHO AVCS base reissue about 8,000 of them were base cells. These on average contain 58% data. The remaining update cells contain about 23% data only. At the very bottom of the pile are updates with only one record. GB5A0052.002, a cancellation cell, contains 3% data only in a file containing 1,887 bytes. There are, however cells with the opposite effect GB200760.001 is 97% data. This is an update which added a small number of features with a high geographical content.

Conclusions:
1. It would seem we compress, encrypt and transport both in hard media and onlinedata but about 40% of it is actual ENC data

2. The rest is specific to the format we have chosen within the product specification to encode the data.

3. Although headers are likely to be highly compressible it does call into question iso8211's use in a world where cell numbers are in the 000s and vessel broadband technology still places a high value on good compression

4. Further analysis of where the choke points are and where the product specification leads to duplication of data could give valuable pointers for S-101 encoding development.