Paper for Consideration by CHRIS 19

S-101 ENC Product Specification

(Next Generation ENCs)

1. Introduction

S-101 is one of a new series of product specifications based on the forthcoming IHO Geospatial Standard for Hydrographic Data – S-100. While many features of S-100 will be used in S-101, in order to maintain a high degree of compatibility with S-57 3.1 these will be limited to elements which improve the content and efficiency of the data. For example ISO/IEC 8211 will remain available and is likely to remain the preferred encoding in S-101. This may change as this paper only outlines the initial thoughts and recommendations of the CHRIS S-57 Transfer Standard Maintenance and Application Development working group (TSMAD). It is intended that the development of S-101 should be progressed with the full co-operation of industry, producers and users, thus benefiting from the many years of experience gained by all.

2. Proposed new and changed content

2.1. General

- S-101 (and all other S-100 based product specifications) will be a stand alone standard and include everything required from the parent standard. It will contain a specific feature catalogue which will preclude the need for prohibitive statements as is the existing case of the S-57 Product Specification. This will enable S-100 itself to remain fully extensible without impacting on published product specifications.
- It is intended to include comprehensive use cases where necessary to promote better understanding of how features should be handled in the ECDIS. There have been instances in the past where data has not been displayed in the manner anticipated. One example being tidal stream information, which initially was displayed as a single string in some ECDIS, when in fact the intention was that the string should be re-formatted as a table.
- The entire tidal content of S-57 needs to be reviewed for S-101, many of the existing features have never been implemented. Either a continuous real time, sensor based, model or functionality enabling predicted modification of tidal levels should be considered.
- S-101 will contain a ENC product specific feature catalogue. This will be version managed independently of the main S-101 content to enable easier updating.
- It is also proposed that S-101 should include a portrayal catalogue that contains the symbology and conditional rules necessary for ECDIS display.

- In S-101 the Feature Catalogue and the Portrayal Catalogue should be managed together as versions and XML exchange formats developed for system delivery.
- Thought will be given on how ENCs will need to interact (if necessary) with other product specifications which overlay and supplement the basic navigation data. This will include both data content and structure.

2.2. Feature Catalogue (UML model in Annex A)

- Several new feature and attribute types which will add new content, flexibility and increased functionality, these include:…….
- A new Information Type (example in Annex A) – this will enable enhanced methods to add information to features e.g. a note which adds supplementary information. Information types can also have child information types e.g. languages.
- A new association Role type – this will replace the existing master/slave mechanism
- A new Complex Attribute Type (example in Annex A) – this will group attributes into logical collections. It will eradicate attributes which contain mixed datatypes e.g. RADWAL (radar wave length – band + frequency), and simplify the current relationship between the nature and quality of the sea bottom.
- New cartographic attributes (anchor point and rotation) will support text placement to improve clarity of display in ECDIS. There is also a need to study exactly what text is really required on the screen – the intent is not to reproduce the paper chart but to convey the information content to a wide range of users in the most effective and 'intuitive' way.
- A redefined grouping method to add flexibility has been developed for S-100. Themes will continue to support the old group 1 and group 2 concept, but now features can be included in multiple themes. This may be useful if the new cell structure at 2.4 is adopted.
- Include various deferred features and attributes from the maintenance document (MD08).
- Remove the line geometric primitive from the feature DEPARE, changes to the method for symbolizing the safety contour makes the requirement redundant.
- Remove 'Unassessed' from the list of values for CATZOC. This value is meaningless and serves no purpose to the user. Invariably the source has been assessed, but not for encoding CATZOC.
- CATZOC should undergo a comprehensive review with harmonization between DQWG and S-44. There is some confusion regarding the definitions of zones of confidence.
- Consider displaying zones of confidence around dangers based on quality attribution to overcome the problem of over reliance on digital data ie because it is digital it must be accurate regardless of the fact that it was surveyed in 1900!
- Consider handling height data (on land) in a similar way to how soundings and other depths are currently handled in water areas. May improve interoperability between the wet and dry fraternities?

2.3. Geometry (example in ISO/IEC 8211 encoding in Annex B)

This will remain fundamentally the same except for the following:

- A change in nomenclature in line with S-100.
- Pure geometry model. Topology can be realized (built) by the receiving system.
- New compound curve enabling a more efficient relationship between a feature and its geometric curve and or its surface.
- Classification of loxodromes will be enabled by the addition of geodesic interpolation on curves.

2.4. Cells

- A new concept to emulate new database driven production methods (figure 1). Two new cell types are being considered:
    - one containing scalable features e.g. lights, buoys, tracks etc.
    - and the other containing non-scalable features e.g. coastline, bathymetry etc

  This will mean more efficient updating, only one scalable feature per geographic location will be required, which in turn will only need to be updated once, unlike the numerous occurrences per cell in the existing format. Experience has shown a high percentage of updates effect these features. This should not invalidate the use of existing cell format in a S-101 ECDIS environment. This may either require the introduction of SCAMAX, or the use of two scalable cells, one for large scale and the other for small scale e.g. a light which would normally exist in a small scale ENC would not necessarily need to be displayed at a large scale.
  A significant number of group 2 area features could also be included if conditional display rules allowed edges normally coincident with the coastlines to overlap the land area at different scales. The area of overlap would not be displayed.
- The use of navigation purpose (colloquially referred to as usage bands) will be redefined to simplify ECDIS loading policy, its use will be confined to building product catalogues.
- A better defined cell scale structure, in line with the proposed new cell structure above. Too much emphasis has been placed on scale, as used in the analogue world, in what is a digital environment. The cell schema should be structured to the level of detail and density of data that is required for a particular navigation need. To achieve this the number of navigational purposes should be reduced to:
    - Overview – small scale world (route planning and oceanic passage).
    - Coastal – medium scale continental shelf (for coastal navigation and approach to pilot points).
    - Harbour entry – current approach and harbour scale data sets combined (Navigation from the pilot point to berth).

Overview and Coastal scale bands should be grid based and the scales fixed globally. There is no reason why the mostly successful INT charting model could not be used, cells being assigned to countries, ignoring International boundaries. Existing 'guidelines' (or lack of) have led to a multitude of differing scales which in turn lead to inefficient and time consuming ECDIS loading strategies.
In addition, a fixed specification in terms of which features (e.g. contours) appear in a particular navigational purpose, will be introduced as part of the overall effort to ensure consistency.

- 'Compilation scale' will be redefined as 'Display Scale' to sever the misleading relationship with paper chart scales. These will continue to be related to radar range scales.
- Relaxation of the 5Mbyte size limit in consultation with OEMs. A large increase could cause problems with cell loading procedures.

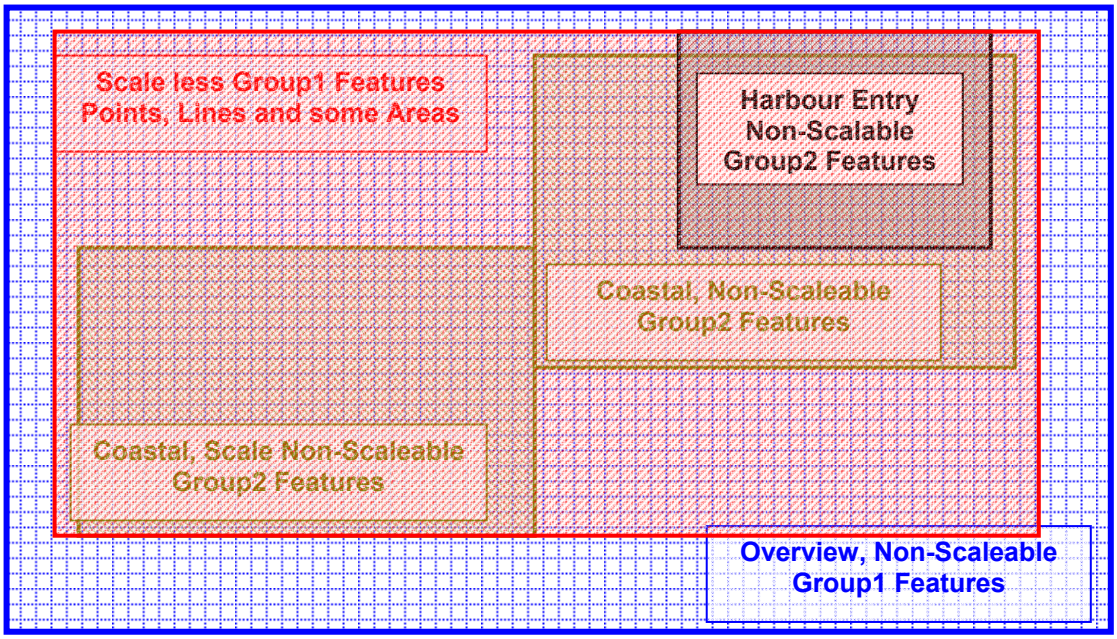

Figure 1 – New Cell Structure

2.5. Text and picture files

- New functionality will enable better housekeeping of redundant files.
- New formats. JPEG2000 will replace tif and others e.g. HTML will be added.
- Need also to consider video

2.6. Exchange Catalogue

The catalogue will be expanded to overcome existing problems in accessing meta information from encrypted data. This will include:

- A new cell title field to facilitate the use of more intuitive cell names e.g. Approach to ……. Harbour.
- A cell coverage polygon to facilitate easier catalogue construction. This may also enable the removal of coverage features in the cell itself.
- More information extracted from the cell meta data e.g. edition number, issue date etc.

2.7. Updating

There is a need to improve the visibility to the user of the data affected by an update and its up-to-dateness. Existing methods used by ECDIS to highlight changes are often hampered by the limited use of the modify instruction in updates. This is a particular problem with changes to geometry where wholesale deletion and insertion of edges do not accurately reproduce the update content and modification to individual vertices would better distinguish actual changes to the data.

The updating mechanism will include a tie in to Notice to Mariners, thus enabling the mariner to see that the update patch has performed the necessary corrections according to the relevant Notice to Mariner.

2.8. Consistency

A new data capture and classification guide is being developed to replace the existing Use of Object Catalogue, which will have mandatory elements, facilitating better consistency of data. These will include mandatory:

- use of SCAMAX/SCAMIN
- edgematching
- regulated contouring
- consistent metrication
- consistent vertical and horizontal datums

3. Aspirations for ECDIS

3.1. Automated upgrades

One of the most frustrating aspects of the existing standards/systems relationship is the need to freeze standards. This is deemed necessary in order to maintain stability, keep cost down, lessen the burden of upgrading on-board systems and the need for new type approval. This has resulted in TSMAD, on numerous occasions, developing workarounds, using existing features/attributes, to cater for the inevitably changing world. In the case of 3.1.1 a new approach has been developed with the introduction of ‘generic’ features and attributes. None of this serves to enhance the quality of the overall product for the user, particularly the latter which involves the display of even more question marks to further confuse the navigation picture.
The proposal is to develop a method, using XML based Feature and Portrayal Catalogues, to automatically update ECDIS. Delivery could be by means of a

dedicated CD, added to regular product CDs and or be downloadable. The S-101 Feature Catalogue would be version controlled and updatable without the need to issue new editions of the main product specification. This would bring S-101 in line with the existing practice used to update the S-52 Presentation Library. New features and symbols could then be implemented in ECDIS immediately they are approved.

Additionally, S-101 will use a portrayal catalogue that will replace the existing S-52 presentation library.

3.2. Conditional symbology

Potential expansion of the concept of including conditional symbology attribution to features as demonstrated in S-57 3.1.1.

3.3. S-57 compatibility

The primary objective is to ensure continuity of service, providing a manageable transition while introducing an improved environment for users.

S-57 ENCs will be capable of being used in a S-101 configured ECDIS. Any new S-101 content or functionality will not be available during the transition period, but this will not detract from the overall usability of the data.

There are several configurations which may be suitable for the use of data in both S-57 and S-101 enabled ECDIS during the transition.

- The ECDIS could be 'multi-fuelled' accepting various types of data in a similar way to that used for existing combinations such as ENC/ECS, ENC/DNC and ENC/RNC.
- Both versions of data could be amalgamated in SENC format prior to final distribution.
- Similarly the data could be amalgamated into one hybrid exchange file organised to contain both common and individual elements of both flavours of ENC.
- Production systems could be re-designed to export both versions.

All these methods (there may be others) are preliminary concepts having many pros and cons which need to be examined, in detail, to develop an effective transition from S-57 to S-101 ENCs.

3.4. Other considerations

The move towards better consistency mentioned earlier should also be reinforced in ECDIS. This could include:

- Ensuring that all ECDIS read the data in the same way, including a common loading policy.
- ECDIS should not display S-58 error and warning messages, it is the responsibility of the producer to guarantee the quality of the data.

- Allow the use of SENC delivery as well as ISO8211.
- Agreed set of defined display scales
- Display priorities more tightly controlled for multi-fuelled systems to default to SENC as base layer.

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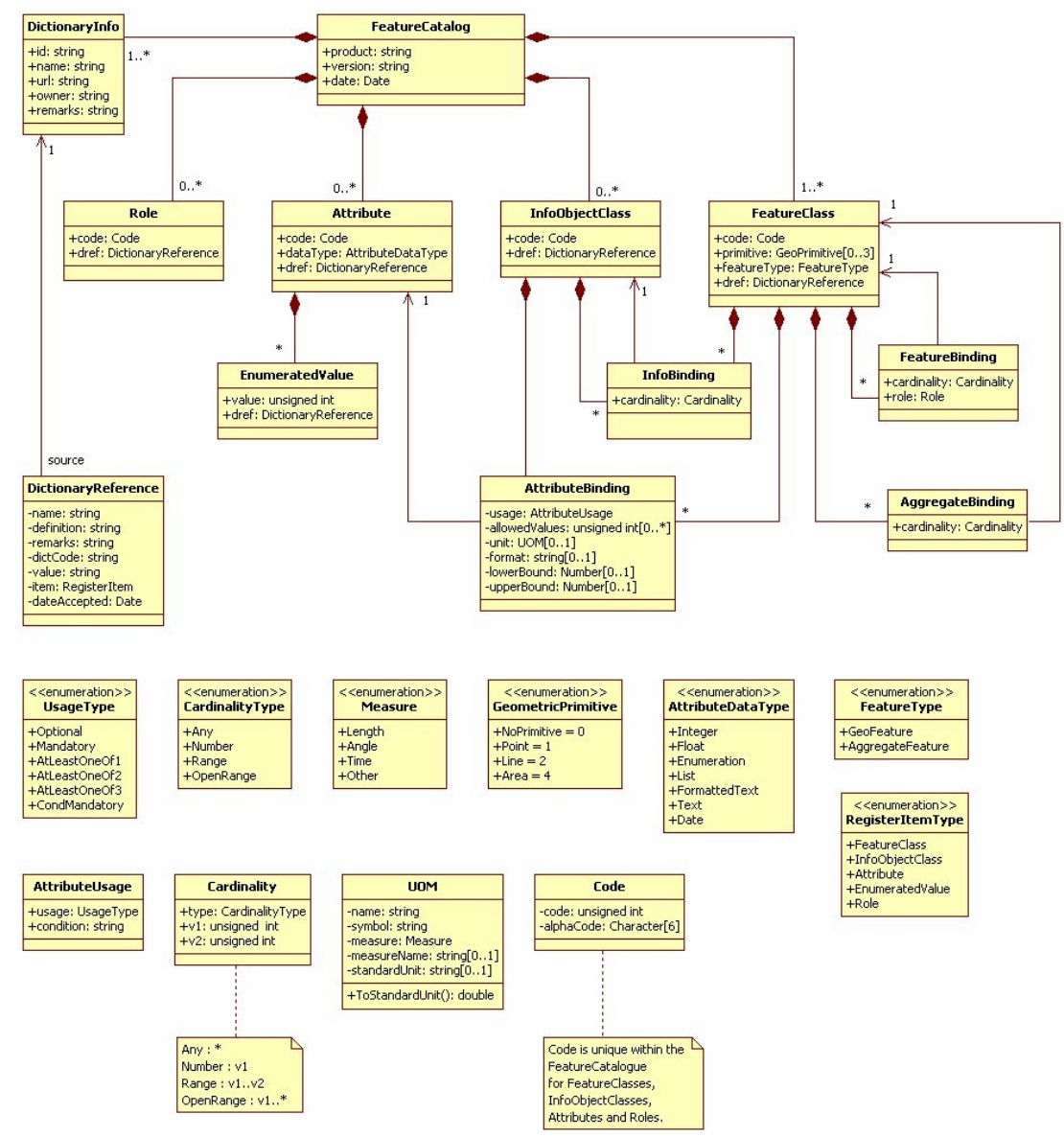
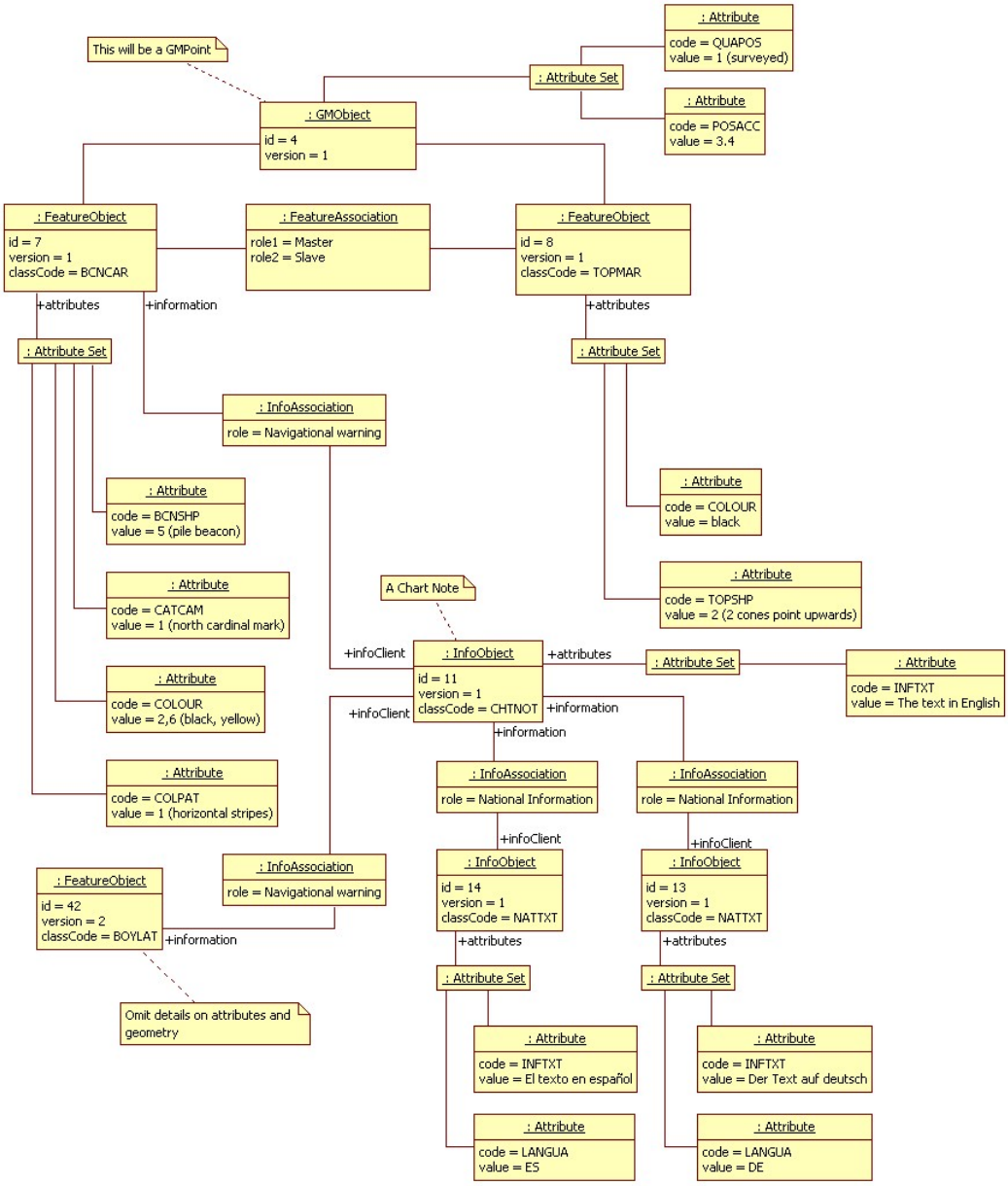
2nd August 2007

Annex A



Feature Catalogue



Feature examples

Annex B

Record structure

Point record

|
|--**0001** (1) : ISO/IEC 8211 Record Identifier
|
|--**VRID** (4) : Vector Record Identifier field
|
|-<R>-**ATTF** (*2) : Attribute field
|
|-<R>-**INFA** (*2) : Information Association field
|
|*alternate coordinate representations*
|
*--**SG2D** (2) : 2-D Coordinate field
|
*--**SG3D** (3) : 3-D Coordinate field

Curve record

|
|--**0001** (1) : ISO/IEC 8211 Record Identifier
|
|--**VRID** (4) : Vector Record Identifier field
|
|-<R>-**ATTF** (*2) : Attribute field
|
|-<R>-**INFA** (*2) : Information Association field
|
|--**PRPT** (*2) : Point Record Pointer field
|
|-<R>-**CSEG** (1) : Segment Header field
|
|*alternate coordinate representations*
|
*-<R>-**SG2D** (*2) : 2-D Coordinate field
|

Composite Curve record

|
|--**0001** (1) : ISO/IEC 8211 Record Identifier
|
|--**VRID** (4) : Vector Record Identifier field
|
|-<R>-**ATTF** (*2) : Attribute field
|
|-<R>-**INFA** (*2) : Information Association field
|
|-<R>-**CRPT** (*2) : Curve Record Pointer field

Surface record

|
|--**0001** (1) : ISO/IEC 8211 Record Identifier
|
|--**VRID** (4) : Vector Record Identifier field
|
|-<R>-**ATTF** (*2) : Attribute field
|
|-<R>-**INFA** (*2) : Information Association field
|
|-<R>-**SRPT** (*3) : Surface Ring Pointer field

Info Object record

|
|--**0001** (1) : ISO/IEC 8211 Record Identifier
|
|--**IRID** (5) : Information Record Identifier field
|
|-<R>-**ATTF** (*2) : Attribute field
|
|-<R>-**INFA** (*2) : Information Association field

Feature Object record

|
|--**0001** (1) : ISO/IEC 8211 Record Identifier
|
|--**FRID** (5) : Feature Record Identifier field
|
|-**FOID** (3) : Feature Object Identifier field
|
|-<R>-**TGRP** (*1) : Thematic Groups field
|
|-<R>-**ATTF** (*2) : Attribute field
|
|-<R>-**INFA** (*2) : Information Association field
|
|-<R>-**FSPT** (*2) : Feature to Spatial Pointer field
|
|-<R>-**AGPT** (*1) : Aggregation Pointer field
|
|-<R>-**ASPT** (*3) : Association Pointer field
|
|-<R>-**MASK** (*1) : Masked Spatial Object fields
|
|-<R>-**TRDL** (*1) : Truncating by the Data Limit field

ISO/IEC 8211 Record Identifier field structure

Field Tag: 0001	Field Name: ISO/IEC 8211 Record Identifier

Subfield name	Label	Format	Subfield content and specification
n/a	n/a	b14	ISO/IEC 8211 Record Identifier

Vector Record Identifier field structure

Field Tag: VRID	Field Name: Vector Record Identifier

Subfield name	Label	Format	Subfield content and specification
Record name	RCNM	b11	{110} Point {120} Curve {130} CompositeCurve {140} 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

Attribute field structure

Field Tag: ATTF	Field Name: Attribute

Subfield name	Label	Format	Subfield content and specification
Attribute label/code	*ATTL	b12	A valid attribute label/code
Attribute value	ATVL	A()	A string containing a valid value for the domain specified by the attribute code in ATTL

Information Association field structure

Field Tag: INFA	Field Name: Information Association

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	Foreign pointer
Association Role	ROLE	b12	A valid Role code

2-D Coordinate field structure

Field Tag: SG2D	Field Name 2-D Coordinate

Subfield name	Label	Format	Subfield content and specification
Coordinate in Y axis	*YCOO	b24	Y coordinate. Format is specified in Appendix B - Product Specifications
Coordinate in X axis	XCOO	b24	X coordinate. Format is specified in Appendix B - Product Specifications

3-D Coordinate field structure

Field Tag: SG3D	Field Name: 3-D Coordinate

Subfield name	Label	Format	Subfield content and specification
Coordinate in Y axis	*YCOO	b24	Y coordinate. Format is specified in Appendix B - Product Specifications
Coordinate in X axis	XCOO	b24	X coordinate. Format is specified in Appendix B - Product Specifications
3-D value	VE3D	b24	Value of third dimension. Content and format are specified in Appendix B - Product Specifications

Point Record Pointer field structure

Field Tag: PRPT	Field Name: Point Record Pointer

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	Foreign pointer
Topology indicator	TOPI	b11	{1} Beginning point {2} End point {3} Beginning & End

Segment Header field structure

Field Tag: SEGH	Field Name: Segment Header

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

Curve Record Pointer field structure

Field Tag: CRPT	Field Name: Curve Record Pointer

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	Foreign pointer
Orientation	ORNT	b11	{1} Forward {2} Reverse

Surface Record Pointer field structure

Field Tag: SRPT	Field Name: Surface Record Pointer

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	Foreign pointer
Orientation	ORNT	b11	{1} Forward {2} Reverse
Usage indicator	USAG	b11	{1} Exterior {2} Interior

Information Record Identifier field structure

Field Tag: IRID	Field Name: Information Record Identifier

Subfield name	Label	Format	Subfield content and specification
Record name	RCNM	b11	{150} Information Object
Record identification number	RCID	b14	Range: 1 to 2^{32}-2
Object code	OBJC	b11	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

Feature Record Identifier field structure

Field Tag: FRID	Field Name: Feature Record Identifier

Subfield name	Label	Format	Subfield content and specification
Record name	RCNM	b11	{100} Feature Object {105} Aggregation Feature Object
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

Feature Object Identifier field structure

Field Tag: FOID	Field Name: Feature Object Identifier

Subfield name	Label	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

Thematic Groups field structure

Field Tag: TGRP	Field Name: Thematic Groups

Subfield name	Label	Format	Subfield content and specification
Group	*GRUP	b12	An identifier for a thematic group of d data set

Feature to Spatial Pointer field structure

Field Tag: FSPT	Field Name: Feature to Spatial pointer

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	A foreign pointer
Orientation	ORNT	b11	{1} Forward {2} Reverse {255} NULL

Aggregation Pointer field structure

Field Tag: AGPT	Field Name: Aggregation Pointer

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	A foreign pointer

Association Pointer field structure

Field Tag: ASPT	Field Name: Association Pointer

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	A foreign pointer
Name	ARLE	b12	A valid code for the association role
Name	CRLE	b12	A valid code for the complementary role

Masked Spatial Object field structure

Field Tag: MASK	Field Name: Masked Spatial Object

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	A foreign pointer

Truncated by the Data Limit field structure

Field Tag: TRDL	Field Name: Truncated by the Data Limit

Subfield name	Label	Format	Subfield content and specification
Name	*NAME	B(40)	A foreign pointer