

**IALA S-201**

**Product Specification**

**Draft 0.0.1 – October 2015**

IALA AtoN Product Specification

**Document Revisions**

Revisions to the IALA Document are to be noted in the table prior to the issue of a revised document.

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| --- | --- | --- |
| **Date** | **Page / Section Revised** | **Requirement for Revision** |
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# Overview

## Introduction

The Aids to Navigation (AtoN) Information Product Specification provides a common structure for the exchange of information about AtoNs. This includes buoys, beacons, racons and lights. The product contains the positions, properties, operational status and general comments related to an AtoN.

The Product Specification can be used to exchange AtoN information in a consistent form between Lighthouse Authorities, Hydrographic Offices and other organizations (*to include commercial and professional agencies)*.

# References

## Normative references

IHO S-63 IHO Data Protection Scheme, Edition 2.0 (under development)

IHO S.100 IHO Universal Hydrographic Data Model, Edition 2.0.0, January 2015

ISO 8601:2004 Data elements and interchange formats \_ Information interchange \_ Representation of dates and times

ISO/TS 19103:2005 Geographic information - Conceptual schema language

ISO 19111:2003 Geographic information - Spatial referencing by coordinates

ISO 19115:2006 Geographic information – Metadata (Tech Corr. 1, 2006)

ISO 19115-2:2009 Geographic information - Metadata: Extensions for imagery and gridded data

ISO 19131:2007 Geographic information - Data product specifications

ISO/IEC 19505-1:2012, Information technology — Open Distributed Processing - Unified Modelling Language Version 2.4.1

## Informative references

ISO, 2006. ISO 19109 Geographic Information - Rules for Application Schema.

ISO, 2007. ISO 19135 Geographic Information – Procedures for Item Registration.

ISO, 2009. ISO 19136 Geographic Information - Geography Markup Language (GML).

IMO, 2008. Safety of Navigation Circular SN/Circ.243

GLA, 2010. R&RNAV Report 03/NW/10, AtoN Information Systems.

IALA, 2012. Guideline 1088 on an Introduction to Preparing S-100 Product Specifications

# Terms, definitions and abbreviations

## Terms and definitions

Terms and definitions have been taken from the normative references cited in clause 1.1. Only those which are specific to this document have been included and modified where necessary. Additional terms are defined in this document.

### coordinate

one of a sequence of numbers designating the position of a point in N-dimensional space [ISO 19111]

### coordinate reference system

coordinate system which is related to the real world by a datum

### coverage

feature that acts as a function to return values from its range for any direct position within its spatial, temporal, or spatiotemporal domain [ISO 19123] EXAMPLE Examples include a digital image, polygon overlay, or digital elevation matrix. NOTE In other words, a coverage is a feature that has multiple values for each attribute type, where each direct position within the geometric representation of the feature has a single value for each attribute type.

### coverage geometry

configuration of the domain of a coverage described in terms of coordinates [ISO 19123]

### direct position

position described by a single set of coordinates within a coordinate reference system [ISO 19107]

### domain

well-defined set [ISO 19103] NOTE Domains are used to define the domain set and range set of operators and functions.

### elevation

the altitude of the ground level of an object, measured from a specified vertical datum. [IHO:S100 GFM]

### feature

abstraction of real world phenomena [ISO 19101] NOTE A feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

### feature attribute

characteristic of a feature [ISO 19109] NOTE A feature attribute type has a name, a data type and a domain associated to it. A feature attribute instance has an attribute value taken from the value domain of the feature attribute type.

### function

rule that associates each element from a **domain** (source, or domain of the function) to a unique element in another domain (target, co-domain, or **range**) [ISO 19107] NOTE The range is defined by another domain.

### geometric object

spatial object representing a set of **direct positions** [ISO 19107] NOTE A geometric object consists of a **geometric primitive**, a collection of geometric primitives, or a geometric complex treated as a single entity. A geometric object may be the spatial characteristics of an object such as a **feature** or a significant part of a feature

### grid

network composed of two or more sets of curves in which the members of each set intersect the members of the other sets in a systematic way [ISO 19123] NOTE The curves partition a space into grid cells.

### grid point

point located at the intersection of two or more curves in a **grid** [ISO 19123]

### height

distance of a point from a chosen reference surface measured upward along a line perpendicular to that surface [ISO 19111:2006] NOTE Height is distinguished from elevation in that it is a directional measurement.

### range

<coverage> set of values associated by a **function** with the elements of the **spatiotemporal domain** of a **coverage** [ISO 19123]

### record

finite, named collection of related items (objects or values) [ISO 19107] NOTE Logically, a record is a set of pairs <name, item >.

### rectified grid

**grid** for which there is a linear relationship between the **grid coordinates** and the coordinates of an external **coordinate reference system** [ISO 19123] NOTE If the coordinate reference system is related to the earth by a datum, the grid is a georectified grid.

### referenceable grid

**grid** associated with a transformation that can be used to convert grid coordinate values to values of **coordinates** referenced to an **external coordinate reference system** [ISO 19123]

### spatiotemporal domain

<coverage> **domain** composed of **geometric objects** described in terms of spatial and/or temporal **coordinates** [ISO 19123] NOTE The spatiotemporal domain of a **continuous coverage** consists of a set of **direct positions** defined in relation to a collection of geometric objects.

### surface

connected 2-dimensional **geometric primitive**, representing the continuous image of a region of a plane [ISO 19107] NOTE The boundary of a surface is the set of oriented, closed curves that delineate the limits of the surface.

### tiling scheme

a discrete grid coverage that is used to partition data into discrete edge matched sets called tiles

### uncertainty

The interval (about a given value) that will contain the true value of the measurement at a specific confidence level [IHO S44] NOTE Errors exist and are the differences between the measured value and the true value. Since the true value is never known it follows that the error itself cannot be known. Uncertainty is a statistical assessment of the likely magnitude of this error.

### vector

quantity having direction as well as magnitude [ISO 19123] NOTE A directed line segment represents a vector if the length and direction of the line segment are equal to the magnitude and direction of the vector. The term vector data refers to data that represents the spatial configuration of features as a set of directed line segments.

## Abbreviations

AtoN Aid to navigation

IALA-AISM International Association of marine aids to navigation and Lighthouse Authorities

CRS Coordinate Reference System

ECDIS Electronic Chart Display Information System

EPSG European Petroleum Survey Group

ENC Electronic Navigational Chart

IHO International Hydrographic Organization

IMO International Maritime Organization

ISO International Organization for Standardization

# Product specification metadata

|  |  |
| --- | --- |
| **Title** | Aids to Navigation Product Specification |
| **S-201 version** | 0.0.1 |
| **S-100 version** | 2.0.0 |
| **Date** |  |
| **Language** | English |
| **Identifier** | S-201 |
| **Classification:** | **001 - unclassified** |
| **Contact:** | IALA-AISM 10, rue des Gaudines 78100 Saint Germain en Laye, France Telephone: +33 1 34 51 70 01 Fax: +33 1 34 51 82 05 |
| **URL:** |  |
| **Maintenance:** | The product specification is maintained by IALA-AISM and amendments are performed on a needs base, up to maximum one new release per calendar year. |

## IALA Product Specification Maintenance

This chapter is for clarification only on PS Maintenance.

### Introduction

Changes to a product specification will be released by IALA-AISM as a new edition, revision, or clarification.

### New Edition

New editionsof a product specification introduce significant changes. *New editions* enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types.

### Revisions

*Revisions* are defined as substantive semantic changes to a product specification. Typically, revisions will change a product specification to correct factual errors; introduce necessary changes that have become evident as a result of practical experience or changing circumstances. A *revision* must not be classified as a clarification. *Revisions* could have an impact on either existing users or future users of a product specification. All cumulative *clarifications* must be included with the release of approved corrections.

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

### Clarification

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

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

### Version Numbers

The associated version control numbering to identify changes (n) to a product specification must be as follows:

New editions denoted as **n**.0.0

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

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

# Specification Scope

This product specification describes one data product and therefore requires only one scope which is described below:

**Scope ID:** Aids to Navigation datasets.

**Hierarchical level:** MD\_ScopeCode - 005

**Hierarchical level name:** dataset.

**Level description:** information applies to the dataset

**Extent:** EX\_GeographicExtent - Global coverage of maritime areas.  
EX\_TemporalExtent - Not defined for this product specification.

EX\_VerticalExtent - Not defined for this product specification.

## Data product Identification

|  |  |
| --- | --- |
| **title** | Aids to Navigation |
| **abstract** | An Aids to Navigation is a vector dataset containing all relevant information regarding the aids to navigation within a defined geographical area. |
| **acronym** | AtoN |
| **content** | Aids to navigation information, such as characteristics of the AtoN, it’s location and maintenance procedures that apply. |
| **spatialExtent** | **Description:** Global  **East Bounding Longitude:** -180  **West Bounding Longitude:** 180  **North Bounding Latitude:** 90  **South Bounding Latitude:** -90 |
| **temporalExtent** | Datasets are valid till a new version is released. |
| **specificPurpose** | Aids to Navigation datasets are produced to allow the producer to exchange AtoN information with interested stakeholders. |

# Data Content and structure

## Introduction

An AtoN Information dataset is a feature-based product. The following sub-sections contain 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 and attribute values in the data product.

The following features and their geometric primitives are used in this product specification. Abstract feature classes are not listed.

|  |  |
| --- | --- |
| Feature name | Geometric primitives available |
| Aggregation | N |
| Association | N |
| BeaconCardinal | P |
| BeaconIsolatedDanger | P |
| BeaconLateral | P |
| BeaconSafeWater | P |
| BeaconSpecialPurposeGeneral | P |
| BuoyCardinal | P |
| BuoyInstallation | P |
| BuoyIsolatedDanger | P |
| BuoyLateral | P |
| BuoySafeWater | P |
| BuoySpecialPurposeGeneral | P |
| Daymark | P |
| EnvironmentObservationEquipment | P |
| FogSignal | P |
| Landmark | P C S |
| Light | P |
| LightFloat | P |
| LightVessel | P |
| NavigationLine | C |
| OffshorePlatform | P S |
| Pile | P |
| RadarTransponderBeacon | P |
| RecommendedTrack | C |
| RetroReflector | P |
| SiloTank | P S |
| Topmark | P |

P=point, C=curve, S=surface, N=none

## Application Schema

The application schema conforms to the modelling conventions of UML as constrained in S-100 Part 1, and conforms to the General Feature Model described in Part 3.

An overview of the application schema is provided in the following figure (Figure 1). The subsequent figures provide details for feature types and their relationships. The allowed values for enumeration attributes are depicted in Figures 4-6. In conformance to S-57 and S-101, navigation aids are (often?) described by combinations of structure and equipment features.

* The feature type AidsToNavigation is an abstract type from which the geographic feature types for navigation aids are ultimately derived.
* StructureObject and Equipment are abstract types which collect the attributes and relationships common to structure and equipment features respectively. The relationship that exists between them is between structure and equipment features is the combining of structure and equipment object(s) to make up an individual navigation aid.
* GenericBeacon and GenericBuoy are abstract types which collect attributes common to multiple types of beacon and buoy features respectively.
* The feature types Aggregation and Association are the equivalent of S-57 collection objects. Their links to the geographic features for individual AtoNs constituting the collection object are are modelled by feature associations (the “Aggregations” and “Associations” links between Aggregation and Association classes and the common supertype for geographic AtoN features (AidsToNavigation). The type of the collection feature is indicated by the attributes IALA\_categoryOfAggregation and IALA\_categoryOfAggregation which can take the allowed values listed in the codelists of the same names.
* Structure-equipment associations are modelled by the association labelled StructureEquipment, between classes Structure and Equipment in Figure 1 below.
* Features participating in the same range system are indicated by the association labelled RangeSystem, between feature classes NavigationLine and RecommendedTrack.
* The structure features are Landmark, Pile, LightFloat, OffShorePlatform, LightVessel, and Silo/Tank features as well as buoys and beacons of different kinds. The detailed models of structure features are depicted in Figure 2.
* The equipment features are daymark, Fog Signal, Radar Reflector, Light, Retroreflector, Topmark, Radar Transponder Beacon, and (IALA) Environmental Observation Equipment. Daymark is allowed to act as either a structure or equipment feature in practice but this cannot at present be modelled in the application schema since S-100 discourages multiple inheritance. The detailed model of equipment features is depicted in Figure 3.
* The feature classes Navigation Line and Recommended Track are neither structure nor equipment objects, and are depicted in complete detail in the overview (Figure 1).

Documentation tables for the application schema are in [(ANNEX F - currently a separate file which should accompany this draft)].



Figure 1. Overview



Figure 2. Structure Objects



Figure 3. Equipment Objects



Figure 4. Enumerations – categories



Figure 5. Enumerations – Color, characteristics, and shape enumerated attributes



Figure 6. Enumerations - Other enumerated attributes



Figure 7. Spatial Attributes

### Meta features application schema

Meta features include data coverage, and areas with established characteristics for navigational systems of marks (buoyage direction and system of marks). The application schema for meta-features is depicted in the diagram that follows.

[Note: The S-122 & S-101 Quality features are not currently part of the S-201 meta-features application schema. TBD by IALA.]



Figure 8. Meta features application schema

## Feature Catalogue

## Introduction

The Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in the product. The S-201 Feature Catalogue is available in an XML document which conforms to the S-100 XML Feature Catalogue Schema and can be downloaded from the IALA website (include URL here). A printed version of the feature catalogue is provided in Annex D.

**Name:** Aids to Navigation Feature Catalogue

**Scope:**

**Version Number:** 1.n

**Version Date:** 2015-mm-dd

**Producer:**

IALA-AISM

10, rue des Gaudines

78100 Saint Germain en Laye, France

Telephone: +33 1 34 51 70 01 Fax: +33 1 34 51 82 05

**Language:** English

## Feature Types

Feature types contain descriptive attributes and do not contain any geometry (i.e. information about the shape and position of a real world entity). Features have two aspects – feature type and feature instance. A feature type is a class and is defined in a Feature Catalogue. A feature instance is a single occurrence of the feature type and represented as an object in a dataset. A feature instance is located by a relationship to one or more spatial instances. A feature instance may exist without referencing a spatial instance.

S-201 makes use of the following feature types:

Geographic (Geo) feature type – carries the descriptive characteristics of a real world entity.

Relationship feature type **–** A feature relationship links instances of one feature type with instances of the same or a different feature type.

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

## Data Product Types

### Introduction

A Dataset is a grouping of features, attributes, geometry and metadata which comprises aspecific coverage. AtoN data is scale independent, but may use the scaleMinimum and scaleMaximum attributes of S100\_GF\_SpatialAttributeType to declutter the data in certain viewing scales. The use of scaleMinimum and scaleMaximum is at the discretion of the data producer.

### Dataset rules

In order to facilitate the efficient processing and cataloguing of AtoN data the geographic coverage may be split into multiple not overlapping datasets. There must be no overlapping datasets, except at the agreed adjoining national data limits, where, if it is difficult to achieve a perfect join, a 5 metre overlapping buffer zone may be used; and for this situation, there must be no gaps in data. The discovery metadata of a dataset must list all the Data Coverage features contained within that dataset.

Datasets are replaced by new editions that must be considered a whole replacement of the previous version. Delta change datasets are not permitted.

Datasets must not exceed 20MB.

## Geometry

The specifications for S-201 geometry are the same as for S-101 geometry except that 3-D geometry is not permitted even for sounding features since these features are not part of the S-201 application schema. The relevant (modified) extract from the S-101 product specification is reproduced below.

The underlying geometry of an [S-201] dataset is constrained to level 3a which supports 0, 1 and 2 dimensional features (points, curves and surfaces) as defined by S-100 Part 7 – Spatial Schema.

Level 3a is described by the following constraints:

* Each curve must reference a start and end point (they may be the same).
* Curves must not self intersect.
* 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 other internal boundaries or the external boundary 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-201] further constrains Level 3a with the following:

* Coincident linear geometry must be avoided when there is a dependency between features.
* The interpolation of GM\_CurveSegment must be loxodromic.
* Linear geometry is defined by curves which are made of curve segments. Each curve segments contains the geographic coordinates as control points and defines an interpolation method between them. The distance between two consecutive control points must not exceed 0.3 mm at a display scale of 1:10000.

The following exception applies to [S-201]:

* The use of coordinates is restricted to two dimensions.
* Soundings features which use GM\_Point or GM\_Multipoint with three dimensional coordinates are not currently included in S-201.

### Co-ordinate Reference Systems (CRS)

#### Introduction

The coordinate reference systems are separated into the horizontal and vertical components.

#### Horizontal Geodetic Datum

WGS84 (World Geodetic System of 1984) must be used for the horizontal reference system for spatial data. WGS84 must be used as the reference ellipsoid.

#### Vertical Datum

Vertical datum shall be selected from the list in verticalDatum enumeration. If the local datum value is used, additional information must be provided using the comment attribute in the metadata, or information attribute on the feature instance.

#### Units of Measure

Units of measure for S-201 datasets must be metres.

# Data Quality

## Introduction

Data Quality is considered to be meta information and for S-201 it is divided into two parts:

* Compliance and integrity
* Uncertainty and lineage

## Data Compliance and Integrity

S-201 datasets must be validated using the conformance checks that are listed in Annex H . The data quality elements listed in S-100 Part 4C that are applicable to S-201 are indicated in the table of conformance checks listed in that Annex.

Datasets must not be published unless they pass all the compliance checks designated as “Critical”.

The detailed results of applying compliance checks listed in Annex H are not required to be reported as part of the exchange set. They may be conveyed as support files or by separate arrangement.

## Uncertainty and lineage information

### Positional accuracy

S-201 positional accuracy data quality indicators do not use the model of data quality data quality elements defined in S-100 Part 4c.

However, positional accuracy must be evaluated and must be indicated in dataset metadata or spatial attribute metadata as provided in the application schema (Figure 7). This specification does not prescribe a specific required level of positional accuracy.

### Lineage

Lineage and process step information elements are not required to be present in S-201 datasets distributed to end user. They may be included as extra metadata in exchange sets distributed to vendors and distributors.

Required source information about S-201 datasets is limited to the source and distribution information contained in discovery metadata described in S-100 Part 4a and Clause ?? of this product specification.

# Data Capture and Classification

The Data Capture and Classification (DCEG) is found in Annex *XX*

# Data Maintenance

## Introduction

Datasets are replaced by new editions that must be considered a whole replacement of the previous version. Delta change datasets are not permitted. Each edition of a dataset shall have an edition number that is greater than the previous version by one. First edition of a dataset shall have edition number set to 1.

## Maintenance and Update Frequency

Datasets are maintained as needed in accordance with data producer policy.

# Portrayal

*<This paragraph is optional.>*

<This section contains the portrayal catalogue or a reference to where it is found. In an S-100 1.0.0 based product specification, the portrayal catalogue is optional. S-100 1.0.0 has no complete portrayal part. If it is considered that portrayal of the data product specified by the product specification is significant enough to specify, a portrayal standard (such as OGC Styled Layer Description) may be used.>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item Name** | **Description** | **M/O** | **Card** | **type** |
| portrayalLibraryCitation | Bibliographic reference to the portrayal library | O | 0..1 | CI\_Citation (ISO 19115) |

# Data Product format (encoding)

## Introduction

The GML encoding of S-201 datasets is based on the S-100 profile of GML 3.2.1. This is described in S-100 Edition 2.0.0 Part 10b.

Detailed documentation of the S-201 encoding schema is provided in Annex B of this document.

**Format Name: S-201 GML**

**Version: 1.0**

**Character Set: UTF-8**

**Specification: S-201 (IALA AToN Product Specification)**

## Encoding of Latitude and Longitude

[This should be reviewed after the data formats are finalized.]

Values of latitude and longitude must be accurate to 7 decimal places. Coordinates must be encoded as decimals in the format described below. The encoding is indicated by multiplication factor fields defined in the dataset identification record by the S-100 GML schemas.

### Encoding of coordinates as decimals

Values should be coded as decimal numbers with 7 or fewer digits after the decimal. The normative encoding is in degrees, with an accuracy of 10-7 degrees, i.e., 7 digits after the decimal point.

The decimal point must be indicated by the “.” character.

Trailing zeroes after the decimal point (and the decimal point itself if appropriate) may be omitted at producer discretion, but the accuracy must still be as indicated (e.g., 10-7 degrees for coordinates of default accuracy).

Latitude and longitude multiplication factors held in the Dataset Structure Information field under [coordMultFactorX] and [coordMultFactorY] must be set to a value corresponding to the encoding, i.e., {1} for coordinates encoded in decimal degrees.

EXAMPLE 1 A longitude = 42.0000 is converted into X = longitude \* coordMultFactorX = 42.0000 \* 1 = 42.0000000.

## Encoding of Depths

[This should be reviewed after the data formats are finalized.]

The default accuracy of encoding of depth values is to 2 decimal places. This product limits the resolution to two decimal places and therefore depths are encoded as decimal metres accurate to two decimal places, i.e, 10-2 metres. The encoding is indicated by a Z multiplication factor field defined in the dataset identification record.

### Encoding of depth values as decimals

Values should be coded as decimal numbers with 2 or fewer digits after the decimal. The normative encoding is in metres, with an accuracy of 10-2 degrees, i.e., 2 digits after the decimal point.

The decimal point must be indicated by the “.” character.

Trailing zeroes after the decimal point (and the decimal point itself if appropriate) may be omitted at producer discretion, but the accuracy must still be as indicated (e.g., 10-2 degrees for of default accuracy).

The [coordMultFactorZ] in the Dataset Structure Information field must be set to {1}. The depth value is indicated by the value in meters. Trailing zeroes after the decimal point may be omitted at producer discretion, but the data accuracy must still be as indicated.

EXAMPLE: A depth = 4.20 m is converted in Z = depth\*coordMultFactorZ = 4.2\*1 = 4.20.

## Numeric Attribute Encoding

Floating point and integer attribute values must not contain leading zeros. Floating point attribute values must not contain non-significant trailing zeros.

## Text Attribute Values

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

## Mandatory Attribute Values

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

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

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

## Unknown Attribute Values

When a mandatory attribute code or tag is present but the attribute value is missing, it means that the producer wishes to indicate that this attribute value is unknown. Missing mandatory attributes must be “nilled” with a GML *nilReason* attribute giving the reason for omission.

Optional attributes must be omitted altogether if the value is unknown or missing. They must not be “nilled.”

EXAMPLE An isolated danger beacon feature has unknown color (mandatory attribute) and condition (optional attribute). The feature could be coded as:

<BeaconIsolatedDanger>

<beaconShape>beacon tower</beaconShape>

<colour nilReason=”unknown”/>

… other attributes…

… <condition> is NOT coded …

<BeaconIsolatedDanger>

## Structure of dataset files

### Sequence of objects

The order of data objects in each dataset file is described below:

Dataset Identification Information

Dataset structure information

Spatial records for by-reference geometries

Point

Multi point

Curve

Composite Curve

Surface

Information objects

Feature objects (Geometry may be encoded inline or by reference.)

Meta features

Geo features

S-201 Collection objects

## Object identifiers

The “name” of feature records must provide a unique world-wide identifier of feature records. The “name” of the record is the combination of the subfields **agency**, **featureObjectIdentifier**, and **featureIdentificationSubdivision** elements of the **featureObjectIdentifier** element of the object.

Features, information types, collection objects, meta features, and geometries (inline or external) are all required by the schema to have a **gml:id** attribute with a value that is unique within the dataset. The **gml:id** values must be used as the reference for the object from another object in the same dataset or another dataset.

## Dataset validation

Fields may be repeated or omitted as permitted by the XML schemas and the validation tests. Since XML schema cannot encode rules for conditional presence or attributes, these rules are checked by Schematron rules or other validation code.

## Location of Data Product Format schema Files

The schema files are available from the locations given below.

| **File** | **Description** | **Version** | **Location** |
| --- | --- | --- | --- |
| S100\_gmlProfile (XSD file) | S-100 GML profile schema | 1.0 | TBD (IHO site) |
| S100\_gmlProfileLevels (XSD file) | Compliance levels schema for the S-100 GML 3.2.1 Profile | 1.0 | TBD (IHO site) |
| S100\_gmlBase (XSD file) | IHO TSMAD S-100 common components schema for S-100 GML data format | 1.0 | TBD (IHO site) |
| S100\_gmlProfileExt (XSD file) | S-201 extensions to the IHO GML profile | 1.0 | TBD (IALA-AISM web site?) |
| S100\_gmlBaseExt (XSD file) | S-201 extensions to the IHO GML common components | 1.0 | TBD (IALA-AISM web site?) |
| S201 (XSD file) | S100 XML/GML Schema for S-201 (IALA Aids To Navigation) | 0.1 | TBD (IALA-AISM web site?) |
| (Schematron files for dataset validation) | [To be developed] | TBD | TBD (IALA-AISM web site?) |
| S201-1.gml (XML/GML file) | S-201 example | 0.1 | TBD (IALA-AISM web site?) |
| OGC GML 3.2.1 schemas | OGC schemas for GML 3.2.1 | 3.2.1 | http://schemas.opengis.net/gml/3.2.1/ |

## Detailed documentation of S-201 XML schema

[The detailed documentation of the S-201 XML schema is in Annex B (currently a separate document enclosed with this file).]

# Data Product Delivery

This clause specifies the encoding and delivery mechanisms for an S-201 dataset. Data which conforms to this product specification must be delivered by means of an exchange set.

## Exchange set

S-201 datasets are grouped into exchange sets. Each exchange set consists of one or more AtoN datasets with an associated XML metadata file and a single Exchange Catalogue XML file containing metadata. It may also include one or more support files.

**Units of Delivery**: Exchange Set

**Transfer Size**: Unlimited

**Medium Name**: Digital data delivery

**Other Delivery Information**:

Each dataset must be contained in a physically separate, uniquely identified file on the transfer medium.

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

Support files are supplementary information which are linked to the features and information types by attributes. The attributes containing these links are described in the application schema and feature catalogue.

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

If the data is transformed (e.g., for encryption or compression purposes) its content must not be changed.

This product specification does not define the transmission encoding which must be used as a default for transmission of data between parties.

The exchange set elements are as follows:

Mandatory Elements

* AtoN datasets – GML encoding of features/attributes and their associated geometry and metadata.
* Exchange Catalogue – the XML encoded representation of exchange set catalogue features [discovery metadata].

Optional Elements

* Supplementary files – These are contained within the exchange set as files and the map from the name included within the dataset and the physical location on the media is defined within the Exchange Catalogue.
* Feature Catalogue – If it is necessary to deliver the latest feature catalogue to the end user it may be done using the S-201 exchange set mechanism for datasets – i.e., include the updated feature catalogue in an exchange set.
* Portrayal Catalogue - If it is necessary to deliver the latest portrayal catalogue to the end user it may be done using the S-201 exchange set mechanism for datasets datasets – i.e., include the updated feature catalogue in an exchange set.

## Dataset

### Datasets

Datasets are distributed as files which are part of exchange sets structured as described in this specification. The distribution media are left to the discretion of the producer and distributor.

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

* New dataset and new edition of a dataset (base dataset): Each new edition of a dataset must have the same name as the dataset that it replaces. A new edition can also be AtoN data that has previously been produced for this area. The encoding structure is located in Annex B.
* Re-issue of a dataset: including all the updates applied to the original dataset up to the date of the reissue. A re-issue does not contain any new information additional to that previously issued by updates. The encoding structure is located in Annex B.
* Cancellation: The dataset is cancelled and is deleted from the SYSTEM. The structure for a cancellation is described in clause 12.2.5.

### Dataset size

Datasets must not exceed 20 MB.

### Dataset file naming

Dataset files shall be named

CCXXXXXXXX\_EEE.GML

The file name forms a unique identifier where:

* CC - the first two characters identify the issuing agency (mandatory).
* the third to tenth characters are optional and may be used in any way by the producer to provide the unique file name. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character \_ (underscore).
* EEE – new editions and re-issues use 000, and increment until a limit of 999 (mandatory).
* the maximum number of characters preceding \_EEE is ten.
* GML – the character sequence “GML” or “gml”.

### New Editions and re-issues

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

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

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

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

### Cancellations

In order to cancel a dataset, a cancellation dataset is created for which the edition number must be set to 0. Dataset edition number is a field in exchange set metadata, class S100\_DatasetDiscoveryMetadata (clause 13.2). The cancellation dataset file may contain no data objects (features, information types, etc.) and any data objects present it in are ignored. The cancellation dataset may be part of an exchange set which contains other datasets, e.g., a new edition of a different dataset. This method is only used to cancel a dataset. Where a dataset is cancelled and its name is reused at a later date, the issue date must be greater than the issue date of the cancelled dataset. When the dataset is cancelled it must be removed from the system.

## Support Files

Dataset 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).Text files may be (TXT), (XML), (HTM) files.

Support files may be in any of the support file formats defined in the S-100 enumeration S100\_SupportFileFormat (defined in Part 4a-D-2.12) except that “Other” may not be used. [This should be discussed, S-101 allows only TXT, HTM, XML, and TIFF.]

### Support File Naming

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

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

CCXXXXXXXX.EEE

The main part forms an identifier where:

* the first two characters identify the issuing agency (mandatory)
* 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 support file name, A to Z, 0 to 9 and the special character \_ (underscore)
* .EEE – support file extension. (Must conform to the file format.)
* the maximum number of characters is ten

### Support file management

When a support file is created or a subsequent version is issued it must carry its own issue date and be supported with a digital signature which authenticates it against the producer’s public key included in the exchange set metadata.

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

Each support file must be used only once in the exchange set.

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

## 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 S201\_1\_0\_CAT.XML. No other file in the exchange set may be named S201\_1\_0\_CAT.XML. The contents of the exchange catalogue are described in Clause 13.

XML schemas for the exchange catalogue are located at [URL TBD – IHO web site.]

# Metadata

## Introduction

The metadata description is based on the S-100 metadata document section, which is a profile of the ISO 19115 standard. These documents provide a structure for describing digital geographic data and define metadata elements, a common set of metadata terminology, definitions and extension procedures.

The realization of exchange set classes, the exchange set catalogue, and the structure of exchange sets are the same as in S-100. The relevant UML diagrams from S-100 are therefore reproduced here for reference.

[If S-201 extends or restricts the S-100 metadata classes, the diagrams must be replaced with customized diagrams. If possible the diagrams should specialize the S-100 classes instead of copying and/or renaming classes.]



Figure 9. Realization of the Exchange Set Classes (from S-100)



Figure 10. Exchange set catalogue and metadata (from S-100)

Since the class S100\_DatasetDiscoveryMetadata aggregates ISO 19115 metadata (class S100\_19115DatasetMetadata), metadata conforming to ISO 19115 is required to be included. Metadata for each support file is required if the exchange set contains support files.



Figure 11. Exchange set including metadata (From S-100)

ISO 19115 metadata conforms to ISO 19115 with the additional constraints in S-100 Part 4A Appendix 4A-B.1 (Table B.1) which make the **fileIdentifier** element mandatory.

## Metadata classes

Details for the S-100 metadata classes are depicted in the figure below.



Figure 12. S-100 and S-201 metadata class details

[Refer to S-100 Edition 2.0.0 Part 4A-D.2 for detailed documentation of S-100 metadata. If S-201 differs, then the S-100 classes should be specialized by S-201 classes if possible and the differences indicated (e.g., figure 4a-2 in S-100 which depicts how S-100 constrains the fileIdentifier attribute of MD\_Metadata to be mandatory).]

### S100\_ExchangeSet

### S100\_ExchangeCatalogue

### S100\_CatalogueIdentifier

### S100\_CataloguePointofContact

### S100\_Dataset

### S100\_DatasetDiscoveryMetadata

The class S100\_DatasetDiscoveryMetadata is not directly used in S-201 metadata. Instead, its specialization S201\_DatasetDiscoveryMetadata (clause 13.2.15) is used.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Role Name** | **Name** | **Description** | **Mult** | **Type** | **Remarks** |
| Class | S100\_DatasetDiscoveryMetadata | Metadata about the individual datasets in the exchange catalogue | - | - | S-100 metadata class |
| Attribute | fileName | Dataset file name | 1 | CharacterString |  |
| Attribute | filePath | Full path from the exchange set root directory | 1 | CharacterString | Path relative to the root directory of the exchange set. The location of the file after the exchange set is unpacked into directory <EXCH\_ROOT> will be <EXCH\_ROOT>/<filePath>/<filename> |
| Attribute | description | Short description giving the area or location covered by the dataset | 1 | CharacterString | E.g. a harbour or port name, between two named locations etc. |
| Attribute | dataProtection | Indicates if the data is encrypted | 0..1 | Boolean | 0 indicates an unencrypted dataset  1 indicates an encrypted dataset |
| Attribute | protectionScheme | specification or method used for data protection | 0..1 | CharacterString | Eg S-63 |
| Attribute | purpose | The purpose for which the dataset has been issued | 1 | MD\_Identification>purpose  CharacterString | E.g. new, re-issue, new edition, update etc. |
| Attribute | specificUsage | The use for which the dataset is intended | 1 | CharacterString | E.g. in the case of ENCs this would be a navigation purpose classification. |
| Attribute | editionNumber | The edition number of the dataset | 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. |
| Attribute | updateNumber | Update number assigned to the dataset and increased by one for each subsequent update | 1 | CharacterString | Update number 0 is assigned to a new dataset. |
| Attribute | updateApplicationDate | this date is only used for the base cell files (i.e. new data sets, re-issue and new edition), not update cell files. All updates dated on or before this date must have been applied by the producer | 0..1 | Date |  |
| Attribute | issueDate | date on which the data was made available by the data producer | 1 | Date |  |
| Attribute | productSpecification | The product specification used to create this dataset | 1 | S100\_ProductSpecification |  |
| Attribute | producingAgency | Agency responsible for producing the data | 1 | CI\_ResponsibleParty |  |
| Attribute | optimumDisplayScale | The scale with which the data is optimally displayed | 0..1 | Integer | Example: A scale |
| Attribute | maximumDisplayScale | The maximum scale with which the data is displayed | 0..1 | Integer |  |
| Attribute | minimumDisplayScale | The minimum scale with which the data is displayed | 0..1 | Integer |  |
| Attribute | horizontalDatumReference | Reference to the register from which the horizontal datum value is taken | 1 | characterString | EPSG |
| Attribute | horizontalDatumValue | Horizontal Datum of the entire dataset | 1 | Integer | 4326 |
| Attribute | verticalDatum | Vertical Datum of the entire dataset | 1 | S100\_VerticalAndSoundingDatum |  |
| Attribute | soundingDatum | Sounding Datum of the entire dataset | 1 | S100\_VerticalAndSoundingDatum |  |
| Attribute | dataType | The encoding format of the dataset | 1 | S100\_DataFormat |  |
| Attribute | otherDataTypeDescription | Encoding format other than those listed. | 0..1 | CharacterString |  |
| Attribute | dataTypeVersion | The version number of the dataType. | 1 | CharacterString |  |
| Attribute | boundingBox | The extent of the cell limits | 0..1 | EX\_GeographicBoundingBox |  |
| Attribute | boundingPolygon | A polygon which defines the actual data limit | 0..\* | EX\_BoundingPolygon |  |
| Attribute | comment | any additional information | 0..1 | CharacterString |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

# Language

The exchange language must be English. Other languages may be used as a supplementary option. National geographic names can be left in their original national language using the complex attribute Feature Name.

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

1. Data Classification and Encoding Guide

[This is a placeholder. The detailed documentation of the S-201 XML schema is currently in a separate document enclosed with this file. See file S-201 Product Specification - draft 0.0.1 Annex A DCEG\_rev3.doc]

1. Data Product Format (Encoding)

[This is a placeholder. The detailed documentation of the S-201 XML schema is currently in a separate document enclosed with this file. See files S-201 Product Specification - draft 0.0.1 Annex B.1-schemas-20150929.zip and S-201 Product Specification - draft 0.0.1 Annex B.2-schema document-20150929.zip]

1. NORMATIVE IMPLEMENTATION GUIDANCE

*IALA to determine if this annex is needed.*

1. FEATURE CATALOGUE

*[See files S-201 Product Specification - draft 0.0.1 Annex D.1 Feature Catalogue.docx and S-201 Product Specification - draft 0.0.1 Annex D.2 Feature Catalogue for S-201 AtoN\_0.0.1.xml]*

1. PORTRAYAL CATALOGUE

To be completed later.

1. Application Schema Documentation Tables

[These are temporarily in a separate document which should accompany this file. See file S-201 Product Specification - draft 0.0.1 Annex F Application Schema Tables.docx]

1. S-201 to S-57 conversion guideline

This annex contain specific guidance that should be followed when converting the S-201 data model to S-57 data model. The annex provides no guidance on converting the S-201 GML encapsulation into S-57 8211 encapsulation.

[insert text here…]

1. S-201 dataset validation rules

[See separate document titled S-201 Product Specification - draft 0.0.1 Annex H data validation tests.docx]