

INTERNATIONAL HYDROGRAPHIC ORGANIZATION

**IHO GEOSPATIAL STANDARD  
FOR MARINE PROTECTED AREAS**

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Marine Protected Areas - Product Specification

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## 1 Introduction

This document has been produced by the IHO Standardisation of Nautical Publications Working Group in response to a requirement to produce a data product that can be used as a Nautical Publication Overlay (NPIO) within an Electronic Chart Display and Information Systems. It is based on the IHO S-100 framework specification and the ISO 19100 series of standards. It is a vector product specification that is primarily intended for encoding the extent and nature of Marine Protected Areas, for navigational purposes.

The United Nations Convention on the Law of the Sea (UNCLOS) identifies certain categories of Marine Protected Areas which may require higher standards of environmental protection. Article 194(5) places an obligation on parties to take measures necessary to protect and preserve rare or fragile ecosystems. Part IX of UNCLOS identifies enclosed or semi-enclosed areas, such as a gulf, bay, basin or sea between two or more countries, as places where countries shall endeavour to coordinate the management of environmental protection activities. In respect of Particularly Sensitive Sea Areas (PSSA), Article 211(6)(a) UNCLOS makes provision for a State to submit to the “competent international organization” (IMO for shipping), special mandatory measures concerning the protection from vessel sourced pollution.

UNCLOS thus creates an overall structure for the protection and preservation of the marine environment and places a general obligation on States to implement global conventions addressing particular forms of pollution protection and regional agreements tailored to the requirements of discrete sea areas.

## 2 Data Product Specification Metadata

This section provides metadata about the creation of this data product specification.

**Title:** IHO S-10X Marine Protected Areas – Data Product Specification

**S-100 Version:** 1.0.0 (January 2010)

**MPA Version:** 0.0.2 Draft

**Date:** Fe 2012

**Language:** English

**Classification:** Unclassified

**Contact:** International Hydrographic Bureau

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## 3 Overview

### 3.1 Informal Description

A Marine Protected Area (MPA) is a protected area whose boundaries include an area of ocean. They include areas of the intertidal or sub-tidal terrain, together with their overlying water and associated flora, fauna, historical and cultural features, which have been reserved by law or other effective means to protect part or all of, the enclosed environment. For example, MPAs may be established to protect fish species, rare habitat area, or entire ecosystems.

MPAs can range from, simple declarations to protect a resource, to areas that are extensively regulated. The degree to which environmental regulations affect shipping varies according to whether MPAs are located in territorial waters, exclusive economic zones, or high seas. These limits are regulated by the law of the sea. Most MPAs are located in the territorial waters of coastal states, where enforcement can be ensured. MPAs can also however be established in a state's exclusive economic zone and even within international waters. For example in 1999, Italy, France and Monaco jointly established a cetacean sanctuary in the Ligurian Sea named the Pelagos Sanctuary for Mediterranean Marine Mammals. This sanctuary includes both national and international waters.

## 4 References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this document.

IHO S-100:2010 IHO Universal Hydrographic Data Model

ISO 19101:2002 Geographic Information - Reference model

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

ISO 19106:2004 Geographic Information - Profiles

ISO 19109:2005 Geographic Information - Rules for Application Schema

ISO 19111:2003 Geographic information - Spatial referencing by coordinates

ISO 19115:2003 Geographic information - Metadata

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

ISO 19123:2005 Geographic information - Schema for coverage geometry and functions

ISO 19129:2009 Geographic information - Imagery gridded and coverage data framework

ISO 19131:2007 Geographic information - Data product specifications

## 5 Terms, definitions and abbreviations

### 5.1 Terms and Definitions

**application**

manipulation and processing of data in support of user requirements (ISO 19101)

**application schema**

**conceptual schema** for data required by one or more **applications** (ISO 19101)

**conceptual model**

model that defines concepts of a **universe of discourse** (ISO 19101)

**conceptual schema**

formal description of a **conceptual model** (ISO 19101)

**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 Raster image, polygon overlay, digital elevation matrix.

**data product**

**dataset** or **dataset series** that conforms to a **data product specification**

**data product specification**

detailed description of a **dataset** or **dataset series** together with additional information that will enable it to be created, supplied to and used by another party

*NOTE: A data product specification provides a description of the universe of discourse and a specification for mapping the universe of discourse to a dataset. It may be used for production, sales, end-use or other purpose.*

**dataset**

identifiable collection of data (ISO 19115)

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

**dataset series**

collection of **datasets** sharing the same product specification (ISO 19115)

**domain**

well-defined set (ISO/TS 19103)

*NOTE: Well-defined means that the definition is both necessary and sufficient, as everything that satisfies the definition is in the set and everything that does not satisfy the definition is necessarily outside the set.*

**feature**

abstraction of real world phenomena (ISO 19101)

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

**feature association**

relationship that links instances of one **feature** type with instances of the same or a different

**feature** type (ISO 19110)

*NOTE 1: A feature association may occur as a type or an instance. Feature association type or feature association instance is used when only one is meant.*

*NOTE 2: Feature associations include aggregation of features.*

**feature attribute**

characteristic of a **feature** (ISO 19101)

*NOTE 1: A feature attribute may occur as a type or an instance. Feature attribute type or feature attribute instance is used when only one is meant.*

*NOTE 2: A feature attribute type has a name, a data type and a domain associated to it. A feature attribute for a feature instance has an attribute value taken from the domain.*

**geographic data**

data with implicit or explicit reference to a location relative to the Earth (ISO 19109)

*NOTE: Geographic information is also used as a term for information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.*

**metadata**

data about data (ISO 19115)

**model**

abstraction of some aspects of reality (ISO 19109)

**portrayal**

presentation of information to humans (ISO 19117)

**quality**

totality of characteristics of a product that bear on its ability to satisfy stated and implied needs (ISO 19101)



## **universe of discourse**

view of the real or hypothetical world that includes everything of interest (ISO 19101)

## **5.2 Abbreviations**

ASCII	American Standard Code for Information Interchange
ENC	Electronic Navigational Chart
GML	Geography Markup Language
IHO	International Hydrographic Organization
IOC	International Oceanographic Commission
ISO	International Organization for Standardization
MPA	Marine Protected Area
MIO	Marine Information Overlay
NPIO	Nautical Publication Information Overlay
UML	Unified Modelling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
WMS	Web Map Service
WFS	Web Feature Service
www	World Wide Web
WGS	World Geodetic System
XML	Extensible Markup Language
XSLT	eXtensible Stylesheet Language Transformations

## **6 Specification Scope**

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

**Scope ID:** Marine Protected Areas 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.

## **7 MPA Data Product Identification**

The following information is required to describe the MPA data product.

**Title:** Nautical Publication Information Overlay - Marine Protected Areas

**Abstract:** Data product describing Marine Protected Areas that are of significance to mariners and others operating within the maritime domain.

**Purpose:** A data product for encoding and transferring MPA information for use as an NIO, within electronic navigational systems such as ECDIS.

**Topic category:** environment, oceans, boundaries (MD\_TopicCategoryCode)

**Content:** A conformant data set contains features defined by the MPA Feature Catalogue and described in the application schema as shown in Figure 2.

**Description:** An S-100 compliant rendering of MPA information.

**Spatial Extent:**  
East Bounding Longitude: 180  
West Bounding Longitude: -180  
North Bounding Latitude: 90  
South Bounding Latitude: -90

**Specific Purpose:** MPA datasets provide information regarding the location and detail of various national and international marine protected areas for navigational purposes.

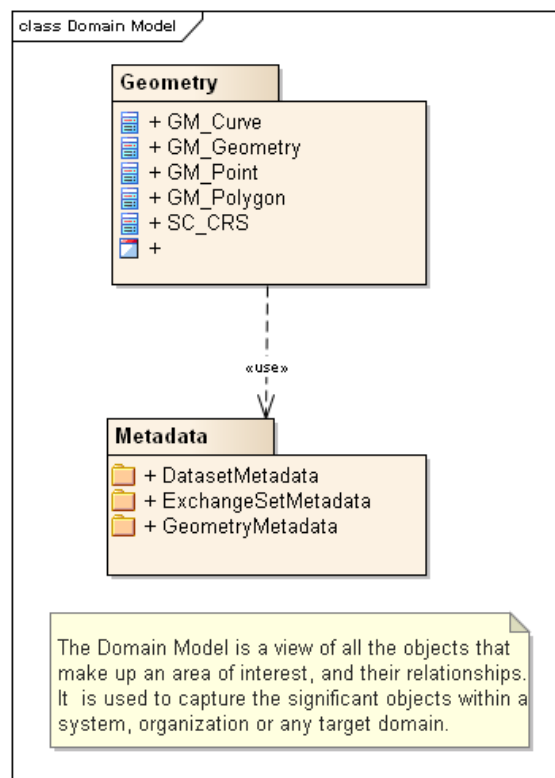
**Spatial representation type:** vector

## 8 Data Content and Structure

The MPA product is based on the S-100 General Feature Model. A General Feature Model is a meta-model of feature types. A feature may have properties that may be operations, attributes or associations. Any feature may have a number of attributes. A feature is not defined in terms of a single geometry, but rather as a conceptually meaningful object within a particular domain, one or more of whose properties may be geometric. The 'Feature' is the fundamental unit of geospatial information, so the Feature Model is the fundamental meta-model used for developing an Application Schema.

This section contains the MPA Application Schema expressed in UML and an associated Feature Catalogue. The Feature Catalogue included at Annex A, provides a full description of each feature type including its attributes, attribute values and relationships in the data product.

MPAs are encoded as vector entities which conform to S-100 geometry configuration level 3b (S-100 section 7-5.3.5).



**Figure 1 - Domain Model Overview**

## 9 Application Schema

The UML model shown in Figure 2 below illustrates a simplified version of the MPA application schema. It includes a general description of elements used to construct the application schema, and the relationships between them. These elements include features types, information types, simple attributes, complex attributes, aggregations and associations. A brief description of these is provided below and the full description is included in the feature catalogue.

A feature is an abstraction of real world phenomena. The `GF_FeatureType` meta-class is instantiated as classes that represent individual feature types.

A certain feature type is the class used to describe all instances of that kind of real world object, e.g. all chimneys irrespective of characteristics (e.g. colour), are encoded as Landmark feature type. In object-oriented modelling, feature types are equivalent to classes and feature instances are equivalent to objects.

An information type is an identifiable object that can be associated with features in order to carry information pertaining to the associated features. `S100_GF_InformationType` is the class intended for information types within S-100. A primary object carrying a Chart Note for example, may contain text in English and an associated supplementary information object may be used to carry the same text in another language.

Simple attributes can be enumerations, codelists or simple types (e.g. integer or character string).

Complex attributes are properties of a feature which can be divided into multiple sub attributes and are used where objects have properties that better fit a hierarchical structure. They provide a better construct for encoding list attributes on objects such as light sectors.

An association is a relationship that links instances of one feature or information type with instances of the same or different feature and information types. Each relationship has a name and two roles thus giving a more detailed representation of the real world relationships within the dataset. The MPA application schema is presented as a UML model in figure 2.







## 9.1 Feature Catalogue

The Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in an MPA. The Feature Catalogue is included as Annex A, and is available from the IHO website (<http://www.iho.int/schemas/MPA/> .....). (Style sheet for including the feature catalogue generated from the xml file needs to be developed)

## 9.2 Coordinate Reference Systems

The coordinate reference system used for this product specification is World Geodetic System 1984 (WGS 84) which is defined by the European Petroleum Survey Group (EPSG) code 4326, (or similar - North American Datum 1983 / Canadian Spatial Reference System).

Spatial data are expressed as latitude ( $\phi$ ) and longitude ( $\lambda$ ) geographic coordinates. Latitude values are stored as a negative number to represent a position south of the Equator. Longitude values are stored as a negative number to represent a position west of the Prime Meridian. Coordinates are expressed as real value, degree / degree decimal format. Datasets conforming to this product specification are not projected.

<b>Horizontal coordinate reference system:</b>	WGS 84
<b>Projection:</b>	None
<b>Vertical coordinate reference system:</b>	Although all coordinates in a data set must refer to the same horizontal CRS different Vertical Datums can be used for the depth component of a coordinate tuple. Therefore the vertical CRS can be repeated. For each Vertical CRS a unique identifier is defined. Those identifiers will be used to indicate which Vertical CRS is used. Units must be in meters. (From S-101 Draft).
<b>Temporal reference system:</b>	Gregorian calendar
<b>Coordinate reference system registry:</b>	<a href="#">EPSG Geodetic Parameter Registry</a>
<b>Date type (according to ISO 19115):</b>	002 - publication

## 10 Geometric representation

Geometric representation is the digital description of the spatial component of an object as described in S-100 and ISO 19107. This product specification uses three types of geometries: GM\_Point, GM\_Curve, and GM\_Polygon (GM\_Surface).

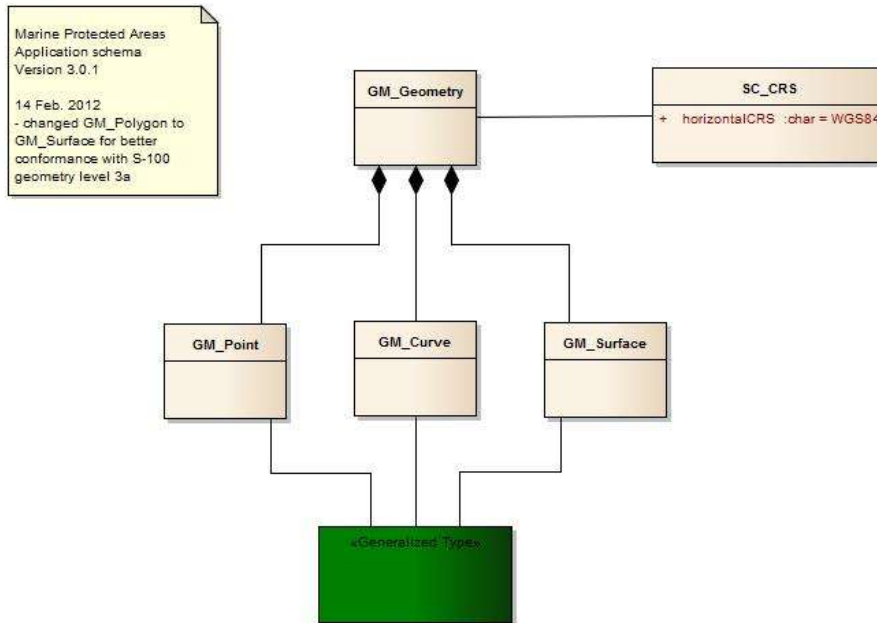


Figure 3 - Geometric Primitives

## 11 Quality

### Spatial data quality

Completeness of information

How current the data is

## 12 Maintenance

**Maintenance and Update Frequency:** Datasets are maintained as needed and must include mechanisms for MPA updating. Data updates will be made by new editions. (This is the current view of SNPWG 14. It may be necessary to introduce incremental updates at a later stage.)

**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.

## 13 Data Encoding

The principal encoding will be the Open Geospatial Consortium (OGC), Geography Markup Language (GML) format. GML is an XML grammar designed to express geographical features. It serves as a modelling language for geographic systems as well as an open interchange format for geographic transactions.

*Note: ENC data cells are delivered in either the ISO 8211 format, or a proprietary internal System ENC (SENC) format. These are binary formats that are machine readable, but are not human readable. Although this product specification, specifies GML as the primary encoding format, it does not preclude the use of other encoding formats.*

## 14 Data Product Delivery Information

This data product specification defines GML as the primary format in which MPA data products are delivered. The delivery format information should include the following items (from ISO 19131:2005 with some changes of obligation): format name, version, specification, language, character set. File structure and units of delivery can also be included if required.



## 14.1 Data product delivery information.

Name	ISO 19131 Elements	Value
Format name	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.formatName	GML*
Version	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.version	3.2.1
Specification description	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.specification	GML*
Language	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.language	English English
Character set	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.characterSet > MD_CharacterSetCode	004 – utf8

**Table 1**

\* GML is an XML encoding for the transport and storage of geographic information, including both the geometry and the properties of geographic features, between distributed systems. The XML Schema for the GML application schema is provided in a single schema document MPA.xsd. ([http://www.iho.int/schemas/MPA ...](http://www.iho.int/schemas/MPA...)). Feature instance shall validate against MPA.xsd and conform to all other requirements specified in this data product specification including all constraints not captured in the XML Schema document.

## 15 Exchange Set

An exchange set will consist of one or more MPA datasets. An exchange set may also include one or more support files containing supplementary information encoded in separate files. These are linked to the MPA dataset features, using the attributes described below. Each exchange set will include a single (XML) catalogue file [content and format to be defined – based on S-101 work] containing discovery metadata for each MPA dataset as well as support files.

### 15.1 Support Files

Support files contain ancillary textual or graphic information in separate (linked) files. Information should be encoded in a structured format as defined by W3C. The following formats would be suitable for graphics:

Portable Network Graphics (PNG) [Edition 2.0]

Scalable Vector Graphics (SVG) [Edition 1.1]

Tagged Image File Format (TIFF) [Edition 6.0]

Joint Photographic Experts Group (JPEG) [Edition xx ]

*Note: PNG is an extensible file format designed for lossless, portable storage of raster images. It provides a patent-free replacement for the GIF format and also replicates many common uses of TIFF. The PNG edition 2 format has been adopted as an ISO standard, (ISO/IEC 15948:2003). SVG is a language for describing two-dimensional graphics in XML [XML10]. SVG allows for three types of graphic objects: vector graphic shapes (e.g., paths consisting of straight lines and curves), images and text. JPEG is a commonly used method of lossy compression for digital imagery. The JPEG standard specifies the codec, which defines how an image is compressed into a stream of bytes and decompressed back into an image, but not the file format used to contain that stream*

## 15.2 Support File Naming Convention

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 (new, replacement and deletion).

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

CCNPIMPAXXXXXXXXX.YYY

The main part forms an identifier where:

- the first two characters identify the issuing agency
- the third to fifth characters must be NPI to identify that this is nautical publication information,
- the sixth to eighth characters must be MPA to identify that this is Maritime Protected Area information,
- the ninth up to the sixteenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character \_ (underscore).
- .YYY – support file extension.

## 15.3 Dataset Naming Convention

All dataset files will have unique world-wide file identifiers. The file identifier of the dataset should not be used to describe the physical content of the file. The dataset file metadata that accompanies the file will inform the user of the name and purpose of the file (new, replacement and deletion).

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

CCNPIMPAXXXXXXXXX.GML

The main part forms an identifier where:

- the first two characters identify the issuing agency
- the third to fifth characters must be NPI to identify that this is nautical publication information,
- the sixth to eighth characters must be MPA to identify that this is Maritime Protected Area information,
- the ninth up to the sixteenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character \_ (underscore).

## 15.4 Catalogue File Naming Convention

The exchange catalogue acts as the table of contents for the exchange set. The catalogue file of the exchange set must be named CATALOG.10X. No other file in the exchange set may be named CATALOG.10X. The content of the exchange catalogue file is described in Section 16.2.1.

## 16 Metadata

The MPA 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.

Two metadata packages are described in this product specification: dataset metadata and exchange set metadata.

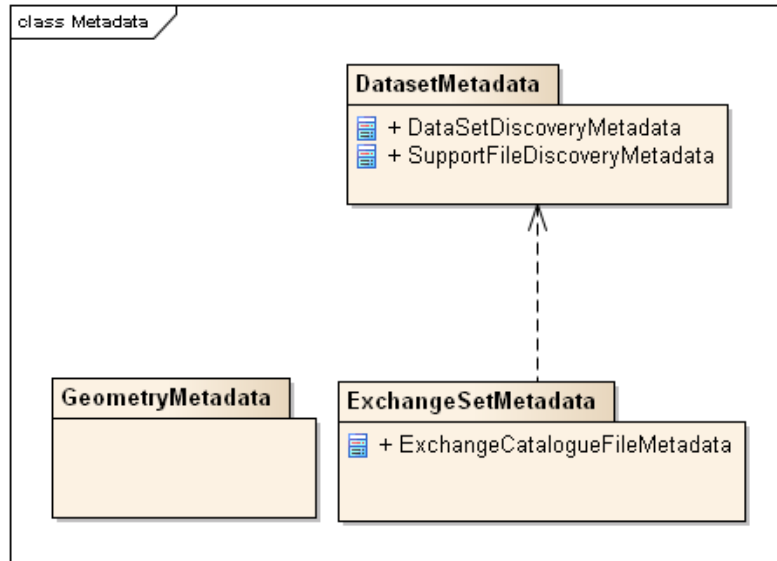


Figure 4 – Metadata

## 16.1 Dataset Metadata

Dataset metadata is intended to describe information about a dataset or data resource. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of a dataset (and / or data resource). Whereas dataset metadata is usually fairly comprehensive, there is also a requirement for a constrained subset of metadata elements that are usually required for discovery purposes. Discovery metadata are often used for building web catalogues, and can help users determine whether a product or service is fit for purpose and where they can be obtained.

### 16.1.1 Information about the documented metadata (if provided as a separate resource)

Name	Cardinality	Value	Type	Remarks
DataSetDiscoveryMetadata				
metadataFileIdentifier	1		CharacterString	See section 15
metadataPointOfContact	1		CI_ResponsibleParty	Contact information for the data production authority
metadataDateStamp	1		Date	When the dataset was created
metadataLanguage	1..2	English or French	CharacterString	All data sets conforming to this PS must use English and optionally French
fileName	1		CharacterString	Dataset file name
filePath	1		CharacterString	Full path from the exchange set root directory
description	1		CharacterString	
dataProtection	1	{1} or {2}	CharacterString	1. Encrypted 2. Unencrypted
purpose	1	{1} or {2}	CharacterString	1. New dataset 2. Terminated
specificUsage	0..1		CharacterString	brief description of the resource and/or resource series usage
editionNumber	1	{1}	Integer	When a dataset is initially created, the edition number "1" is assigned to it. The edition number is increased by one with each new edition.

issueDate	1		Date	Date on which the dataset was generated.
productSpecification	1	MPA version XXX	CharacterString	This must be encoded as MPA XXX
producingAgency	1		CI_ResponsibleParty	Party responsible for generating the dataset.
horizontalDatum	1	WGS84	CharacterString	The datum for latitude/longitude. EPSG:4326
verticalDatum	1	WGS84	CharacterString	EPSG:4326
dataType	1	GML 3.2.1	CharacterString	
boundingBox	0..1		EX_GeographicBoundingBox	minimum bounding rectangle within which data is available
boundingPolygon	1..*		EX_BoundingPolygon	boundary enclosing the dataset, expressed as the closed set of (x,y) coordinates of the polygon (last point replicates first point)
geographicDescription	0..1	e.g. Norway	EX_GeographicDescription	description of the geographic area within which data is available
comment	0..1		CharacterString	Any additional Information

**Table 2**

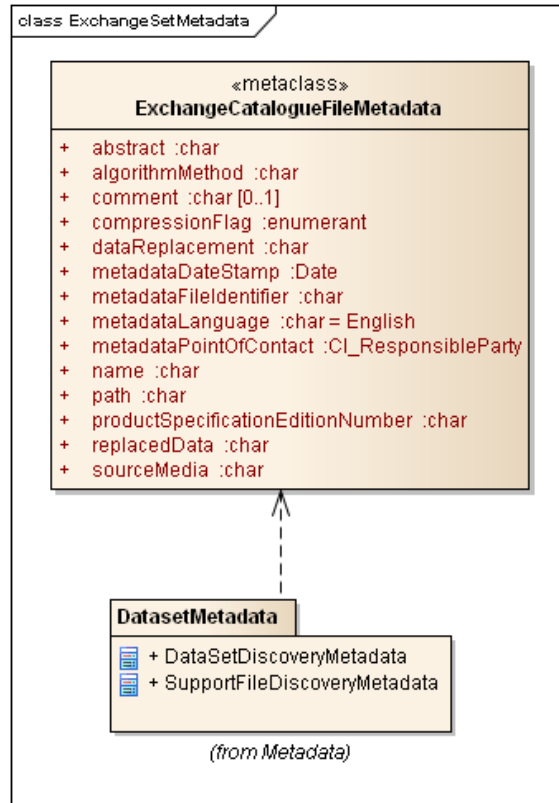
*Note 1: Types with CI\_, EX\_, and MD\_ prefixes are from packages defined in ISO 19115 and adapted by S-100. Types with S100\_ prefix are from packages defined in S-100.*

*Note 2: When a dataset is terminated, the purpose metadata field is set to 2 (terminated), and the editionNumber metadata field is set to 0. All other metadata fields must be blank.*

*Note 3: The implication of only updating by new edition is that, if a support file is terminated, a new edition of the dataset is required.*

## **16.2 Exchange Set Metadata**

Frequently datasets are packaged and distributed as composite exchange sets by third party vendors. An exchange set could contain many different types of datasets, sourced from different data producers. For example an exchange set may contain numerous dataset files, ancillary data files, discovery metadata files and others. Exchange set metadata contains metadata about the contents of the exchange set and metadata about the data distributor.



**Figure 5 Exchange Set Metadata**

**16.2.1 Catalogue File Metadata.**

All MPA Catalogue metadata files must contain at least the following metadata elements.

Name	Cardinality	Value	Type	Remarks
abstract	0..1		CharacterString	Description of what the exchange catalogue contains
AlgorithmMethod	0..1	e.g. ZIP Compression	CharacterString	algorithms or processes that are applied to read or expand resources to which compression techniques have been applied
metadataFileIdentifier	1		CharacterString	See section 15
metadataPointOfContact	1		CI_ResponsibleParty	Contact information for the data production authority
metadataDateStamp	1		Date	Date when the dataset was created
metadataLanguage	1..2	English, French	CharacterString	All data sets conforming to this PS must use English language. The catalogue file must be in English with the optional addition of French.
name	1	CATALOG.MPA	CharacterString	Catalogue filename
path	1	URI	CharacterString	Path to filename

productSpecification	1	MPA X.X.X	CharacterString	Product specification Version Number
comment	0..1		CharacterString	Any additional Information

Table 2

## 17 Portrayal

See attribute category of restricted area CATREA enumerations: (i.e. offshore safety zone, nature reserve, bird sanctuary, game reserve, seal sanctuary ....)

Include the portrayal section when completed.

## **ANNEX A – Feature Catalogue**

It was agreed at TSMAD 14 that this would make reference to the digital FC.  
See mpa.xsd,