

Marine Harbour Infrastructure Product Specification

Edition 2.0.0 – January 2026

IHO



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Organization

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Document History

Changes to this Specification are coordinated by the Nautical Information Provision Working Group, an IHO working group under HSSC. New editions will be made available via the IHO web site. Maintenance of the Specification shall conform to IHO Resolution 2/2007 (as amended).

Version Number	Date	Approved By	Purpose
1.0.0	2022-08-18		Draft 1
1.0.0	2022-08-22		Revised Draft 1
1.0.0	2022-11-25	RM	Draft 2. Applied feedback from NIPWG after NIPWG9; added guidelines for portrayal of schedules and applicability; miscellaneous editorial revisions.
1.0.0	2023-01-10	RM	Added HarbourFacility to Figure 4.14; clarifications for ISO metadata and file naming; version date updated to sync. with other artefacts.
2.0.0	2025-12-07	RM	Draft Edition 2.0.0; apply amendments accepted by task group; align with S-100 5.2.0; align with S-127 and S-122 Editions 2.0.0.
2.0.0	2025-12-24	RM	Draft Edition 2.0.0; Added S-401 reference; UML diagrams updated for legibility and GI registry activity
2.0.0	2026-01-14	RM	Updated with feedback received as of Jan. 14, 2026

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1 Overview

1.1 Introduction

S-131 is the Marine Harbour Infrastructure (MHI) Product Specification, produced by the International Hydrographic Organization. S-131 is designed to allow content, content definition (Feature Catalogues) and presentation (Portrayal Catalogues) to be updateable without breaking system implementations.

This document has been produced by the IHO Nautical Information Provision Working Group (NIPWG) in response to a requirement to produce a data product that can be used as a Nautical Publication Information Overlay (NPIO) within an Electronic Chart Display and Information Systems (ECDIS). 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 intended for encoding information relating to port and harbour facilities for facilitating berth-to-berth navigation.

Marine Harbour Infrastructure (MHI) datasets describe the layout of ports and the availability of port services. This includes facility locations, service areas, services offered, and instructions for contacting or utilizing these services. MHI is intended to be a supplement to ENC, and therefore does not describe the geographic information in detail equal to ENC.

1.2 Scope

This document describes an S-100 compliant Product Specification for Marine Harbour Infrastructure, which will form an overlay layer for an S-100 based marine navigation system. It specifies the content, structure, and metadata needed for creating a fully compliant S-131 product and for its portrayal within an S-100 system. This Product Specification includes the content model, the encoding, the Feature Catalogue, Portrayal Catalogue, and metadata.

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1.4 Terms, definitions and abbreviations

1.4.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

accuracy

Closeness of agreement between a test result and the accepted reference values.

NOTE: A test result can be from an observation or measurement.

aggregation

Special form of **association** that specifies a whole-part relationship between the aggregate (whole) and a component part.

alarm

(MSC.302/A) a high-priority **alert**. Condition requiring immediate attention and action by the bridge team, to maintain the safe navigation of the ship.

alert

(MSC.302/A) announcement of abnormal situations and conditions requiring attention. Alerts are divided in four priorities: **emergency alarms**, **alarms**, **warnings** and **cautions**. An alert provides information about a defined state change in connection with information about how to announce this event in a defined way to the system and the operator.

application schema

Conceptual schema for data required by one or more applications.

association

Semantic relationship between two or more classifiers that specifies connections among their instances.

attribute

(1) Named property of an entity.

NOTE: Describes a geometrical, topological, thematic, or other characteristic of an entity.

(2) Feature within a classifier that describes a range of values that instances of the classifier may hold.

NOTE: An attribute is semantically equivalent to a composition association; however, the intent and usage is normally different.

NOTE: “Feature” used in this definition is the UML meaning of the term.

boundary

Set that represents the limit of an entity.

NOTE: Boundary is most commonly used in the context of geometry, where the set is a collection of points or a collection of objects that represent those points.

caution

(MSC.302/A) lowest priority of an **alert**. Awareness of a condition which does not warrant an **alarm** or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information.

class

Description of a set of objects that share the same *attribute*s, operations, methods, *relationship*s, and semantics.

NOTE: A class represents a concept within the system being modelled. Depending on the kind of model, the concept may be real-world (for an analysis model), or it may also contain algorithmic and computer implementation concepts (for a design model). A classifier is a generalization of class that includes other class-like elements, such as data type, actor and component.

classification

The process of determining the appropriate **data type** within a **feature catalogue** for a particular real world feature, including consideration of **data quality**.

coordinate

One of a sequence of n numbers designating the position of a **point** in n-dimensional space.

NOTE: In a **coordinate reference system**, the coordinate numbers are qualified by units.

coordinate reference system

Coordinate system that is related to an object by a datum.

NOTE: For geodetic and vertical datums, the object will be the Earth.

coordinate tuple

Ordered list of **coordinates**.

curve

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

NOTE: The boundary of a curve is the set of points at either end of the curve. If the curve is a cycle, the two ends are identical, and the curve (if topologically closed) is considered to not have a boundary. The first point is called the start point, and the last is the end point. Connectivity of the curve is guaranteed by the “continuous image of a line” clause. A topological theorem states that a continuous image of a connected set is connected.

curve segment

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

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

data product

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

data quality

A set of elements describing aspects of quality, including a measure of quality, an evaluation procedure, a quality result, and a scope.

data type

Specification of a value domain with operations allowed on values in this domain.

NOTE: Data types include primitive predefined types and user-definable types.

NOTE: A data type is identified by a term, for example Integer.

EXAMPLE Integer, Real, Boolean, String, DirectPosition and Date

dataset

An identifiable collection of data.

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

datum

Parameter or set of parameters that define the position of the origin, the scale, and the orientation of a **coordinate system**.

display priority

Hierarchy to determine which **feature** is to be displayed when two features overlap. Priority 2 overwrites 1.

enumeration

A fixed list of valid identifiers of named literal values. **Attributes** of an enumerated type may only take values from this list.

feature

Abstraction of real world phenomena.

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

EXAMPLE The phenomenon named 'London Eye' may be classified as a feature instance with other phenomena into a feature type 'landmark'

feature association

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

feature attribute

Characteristic of a **feature**.

NOTE: 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: 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.

NOTE: In a **feature catalogue**, a feature **attribute** may include a value domain but does not specify **attribute** values for feature instances.

EXAMPLE 1 A feature attribute named *communication channel* may have an attribute value *VHF0007* which belongs to the data type *text*

EXAMPLE 2 A feature attribute named *length* may have an attribute value *82.4* which belongs to the data type *real*

feature catalogue

A catalogue containing definitions and descriptions of the **feature** types, **feature attributes**, and **feature associations** occurring in one or more sets of geographic data.

geometric primitive

Geometric object representing a single, connected, homogeneous element of geometry.

NOTE: Geometric primitives are non-decomposed objects that present information about geometric configuration. They include points, curves, surfaces, and solids.

human readable

A representation of information that can be naturally read by humans.

identifier

A linguistically independent sequence of characters capable of uniquely and permanently identifying that with which it is associated.

indication

Visual indication giving information about the condition of a system or equipment.

instance

Entity to which a set of operations can be applied and which has a state that stores the effects of the operations.

NOTE: See **feature**.

loxodrome

A loxodrome is a line crossing all meridians at the same angle, that is, a path of constant bearing.

machine readable

A representation of information that can be processed by computers.

maximum display scale

The larger value of the ratio of the linear dimensions of features of a dataset presented in the display and the actual dimensions of the features represented (largest scale) of the scale range of the dataset.

metadata

Data about data.

minimum display scale

The smaller value of the ratio of the linear dimensions of features of a dataset presented in the display and the actual dimensions of the features represented (smallest scale) of the scale range of the dataset.

model

Abstraction of some aspects of universe of discourse.

NOTE: A semantically complete abstraction of a system.

multiplicity

Specification of the number of possible occurrences of a property, or the number of allowable elements that may participate in a given relationship.

EXAMPLE 1..* (one to many); 1 (exactly one); 0..1 (zero or one)

overscale

The viewing scale is larger than the value considered by the data producer to be the largest intended (maximum) display scale for the data.

point

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

NOTE: The **boundary** of a point is the empty set.

portrayal catalogue

Collection of defined portrayals for a **feature catalogue**.

NOTE: Content of a portrayal catalogue includes portrayal functions, symbols, and portrayal context.

relationship

Semantic connection among model elements.

NOTE: Kinds of relationships include association, generalization, metarelationship, flow, and several kinds grouped under dependency.

scale minimum

The smallest scale at which a feature is displayed (for example, a minor light, with a scale minimum of 1:45,000, would not be displayed at a scale of 1:90,000).

surface

Connected 2-dimensional **geometric primitive**, representing the continuous image of a region of a plane.

NOTE: The boundary of a surface is the set of oriented, closed **curves** that delineate the limits of the surface.

symbol size

The size is specified in normalized units of 0.01 mm. The minimum dimension is always more than 4 mm. This size applies to display on a standard minimum screen.

text label

A textual description of a **feature**. Can be formatted to include standard text as well as **feature attribute** values. For example, light descriptions, place names etc.

transparent fill

A method of identifying features of **geometric primitive surface** by covering a given percentage of each 4 pixel square with the fill colour, leaving the remainder “transparent”. Used to ensure the information underneath shows through.

vertical datum

Datum describing the relation of gravity-related heights or depths to the Earth.

warning

(MSC.302/A) **alert** for condition requiring immediate attention, but no immediate action by the bridge team. Warnings are presented for precautionary reasons to make the bridge team aware of changed conditions which are not immediately hazardous, but may become so if no action is taken.

1.4.2 Abbreviated terms

This product specification adopts the following convention for symbols and abbreviated terms.

CRS	Coordinate Reference System
DCEG	Data Classification and Encoding Guide
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Chart
EPSG	European Petroleum Survey Group
GFM	General Feature Model
GML	Geography Markup Language
IEC	International Electrotechnical Commission
IEHG	Inland ENC Harmonization Group
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization
JPEG	Joint Photographic Experts Group

KiB	IEC 80000-13 unit corresponding to 2^{10} bytes
MHI	Marine Harbour Infrastructure
MiB	IEC 80000-13 unit corresponding to 2^{20} bytes
MRN	Maritime Resource Name
MSVS	Mariners Selected Viewing Scale
NIPWG	Nautical Information Provision Working Group
S-100WG	IHO S-100 Working Group
SD	System Database
SOLAS	Safety of Life at Sea
SVG	Scalable Vector Graphics
TIFF	Tagged Image File Format
UML	Unified Modelling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
UTC	Coordinated Universal Time
XML	eXtensible Markup Language
XSD	XML Schema Definition
XSLT	eXtensible Stylesheet Language Transformations

1.5 Use of language

Within this document:

- “Must” indicates a mandatory requirement.
- “Should” indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.
- “May” means “allowed to” or “could possibly”, and is not mandatory.

1.6 General data product description

NOTE: This information contains general information about the data product.

Title: Marine Harbour Infrastructure

Abstract: Marine Harbour Infrastructure (MHI) datasets describe the layout of port facilities and the availability of port services. MHI is intended to facilitate berth-to-berth navigation and voyage planning. MHI is intended to be a supplement to ENC, and therefore does not describe the geographic information in detail equal to an ENC.

Content: Datasets conforming to this specification will contain all relevant MHI information for the area of coverage. Additionally, there will be relevant metadata data quality, production authority, data sources, and publication date.

Spatial Extent: **Description:** Global coverage of ports and harbours and their environs.

East Bounding Longitude: 180°

West Bounding Longitude: -180°

North Bounding Latitude: 90°

South Bounding Latitude: -90°

Purpose: The purpose of an MHI dataset is to provide information to mariners for use in berth-to-berth navigation and voyage planning.

1.7 Data Product Specification metadata

NOTE: The information in this clause identifies this Product Specification and provides information about its creation and maintenance. Dataset metadata is described in a separate clause.

Title: Marine Harbour Infrastructure Product Specification

S-100 5.2.0

Version:

S-131 2.0.0

Version:

Date: 14 January 2026

Language: English

Classification: Unclassified

Contact: International Hydrographic Organization

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URL: <https://iho.int>

Identifier: S-131

Maintenance: Changes to the S-131 Product Specification are coordinated by the Nautical Information Provision Working Group, a technical group established by the International Hydrographic Organization, and are made available via the IHO web site. Maintenance of the Product Specification must conform to IHO Resolution 2/2007, as amended.

1.8 IHO Product Specification maintenance

1.8.1 Introduction

Changes to S-131 will be released by the IHO as a New Edition, revision, or clarification.

1.8.2 New Edition

New Editions of S-131 introduce significant changes. *New Editions* enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types. *New Editions* are likely to have a significant impact on either existing users or future users of S-131. All cumulative *revisions* and *clarifications* must be included with the release of approved New Editions.

1.8.3 Revision

Revisions are defined as substantive semantic changes to S-131. Typically, *revisions* will change S-131 to correct factual errors; or 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 S-131. All cumulative *clarifications* must be included with the release of approved corrections revisions.

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 dataset of one version could always be processed with a later version of the Feature and Portrayal Catalogues.

In most cases a new Feature Catalogue will result in a *revision* of S-131.

1.8.4 Clarification

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

Changes in a *clarification* are minor and ensure backward compatibility with the previous versions.

1.8.5 Version numbers

The associated version control numbering to identify changes (n) to this 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

2 Specification Scope

Scope ID:	Global
Level:	006—series
Level name:	MHI Dataset

3 Dataset Identification

A dataset that conforms to this Product Specification may be identified by its discovery metadata as defined in clause [14](#).

Title:	Marine Harbour Infrastructure
Alternate Title:	MHI
Abstract:	S-131 datasets must be produced in accordance with the rules defined in the S-131 Product Specification. The S-131 Product Specification contains all the information necessary to enable producers to produce a consistent MHI dataset; and manufacturers to use that data efficiently within navigation systems.
Topic Category:	Transportation (ISO 19115-1 MD_TopicCategoryCode 018)
Geographic Description:	Ports and harbours in areas specific to marine navigation
Spatial Resolution:	MD_Resolution>equivalentScale.denominator (integer) or MD_Resolution>levelOfDetail (CharacterString). E.g.: "All scales" An MHI dataset must indicate a value for maximum display scale. Each Data Coverage feature must also carry a value for minimum display scale. Recommended values for scales can be found in the S-101 ENC Product Specification. Producers should note that at the smaller scales, geographic details within ports will have no perceptible visual separation on a graphic display, and are therefore encouraged to determine display scales taking into account the content and intended navigation purpose of the dataset.
Purpose:	Information about ports and harbours for use in Electronic Chart Display and Information Systems

Language:	English (Mandatory), other (Optional)
Classification:	Data may be classified as one of the following: <ol style="list-style-type: none">1) Unclassified;2) Restricted;3) Confidential;4) Secret;5) Top Secret;6) Sensitive but Unclassified;7) For Official Use Only;8) Protected; or9) Limited Distribution.
Spatial Representation Type:	Vector
Point of Contact:	Producing Agency
Use Limitation:	Not for sole use in navigation; must be used with an ENC.

4 Data Content and Structure

4.1 Introduction

The S-131 product is based on the S-100 General Feature Model (GFM), and is a feature-based vector product. [Figure 4-1](#) shows how the S-131 application schema is realized from the S-100 GFM. All S-131 features and information classes are derived from one of the abstract classes **FeatureType** and **InformationType** defined in the S-131 application schema, which realize the GFM meta-classes S100_GF_FeatureType and S100_GF_InformationType respectively.

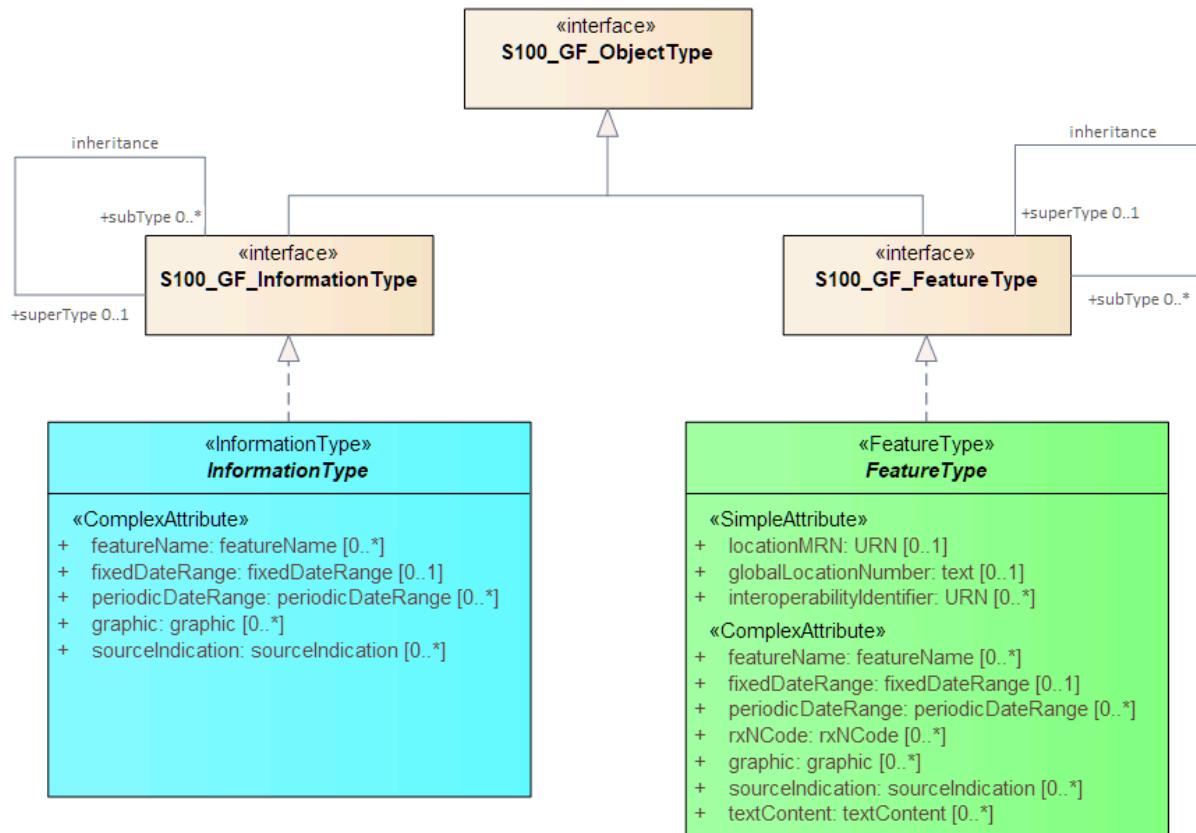


Figure 4-1 — Realizations from the S-100 General Feature Model

4.2 Application Schema

S-131 conforms to the General Feature Model (GFM) from S-100 Part 3. This document describes the Application Schema expressed in UML. This document contains only an overview of the S-131 application schema. The S-131 Application Schema types are realised in the Feature Catalogue. The Feature Catalogue is included as a separate Annex (Annex C), and provides a full specification of all types including feature and information types, their attributes, allowed values, and relationships between types in the data product.

The following conventions are used in the UML diagrams depicting the application schema:

- Standard UML conventions for classes, associations, inheritance, roles, and multiplicities apply. These conventions are described in Part 1 of S-100.
- Italic font for a class name indicates an abstract class.
- Feature classes are depicted with green background; the dark shade for abstract feature classes and the light shade for ordinary (non-abstract) feature classes.
- Information type classes are depicted with blue background; the dark shade for abstract information type classes and the light shade for ordinary information types.
- Association classes are depicted with a white background.
- Complex attributes are depicted with a pink background.
- Enumeration lists and codelists are depicted with a tan background. The numeric code corresponding to each listed value is shown to its right following an '=' sign.
- No significance attaches to the colour of associations. (Complex diagrams may use different colours to distinguish associations that cross one another.)
- Where the association role or name is not explicitly shown, the default rules for roles and names apply:

- The role name is ‘the<CLASSNAME>’ where <CLASSNAME> is the name of the class to which that association end is linked.
- The association name is ‘<CLASSNAME1>_<CLASSNAME2>’ where <CLASSNAME1> is the source and <CLASSNAME2> the target. In case of a feature/information association the feature is the source. For feature/feature or information/information associations without explicit names the source/target are indicated by an arrowhead.
- Subclasses inherit the attributes and associations of their superclasses at all levels, unless such inheritance is explicitly overridden in the subclass.

4.2.1 Domain model

The S-131 domain model has two base classes ('root classes') from which all the domain-specific geographic features and information type classes are derived. The base classes are shown in [Figure 4-2](#) below. The base class for geographic features is **FeatureType** and the base class for information types is **InformationType**. Each of the two base classes has a set of attributes which are therefore inherited by all domain-specific features. The approximate area features in S-131 are also derived from the geographic feature root class. Both base classes are abstract classes and do not have direct instances in S-131 data —instead, S-131 feature and information type data objects are instantiations of a non-abstract class derived from one of these base classes.

S-131 meta- and cartographic features are not derived from these base classes—S-131 instead incorporates meta- and cartographic feature definitions originally prepared for S-101 in the interests of harmonization and interoperability with other S-100-based data products, especially S-101 ENCs.

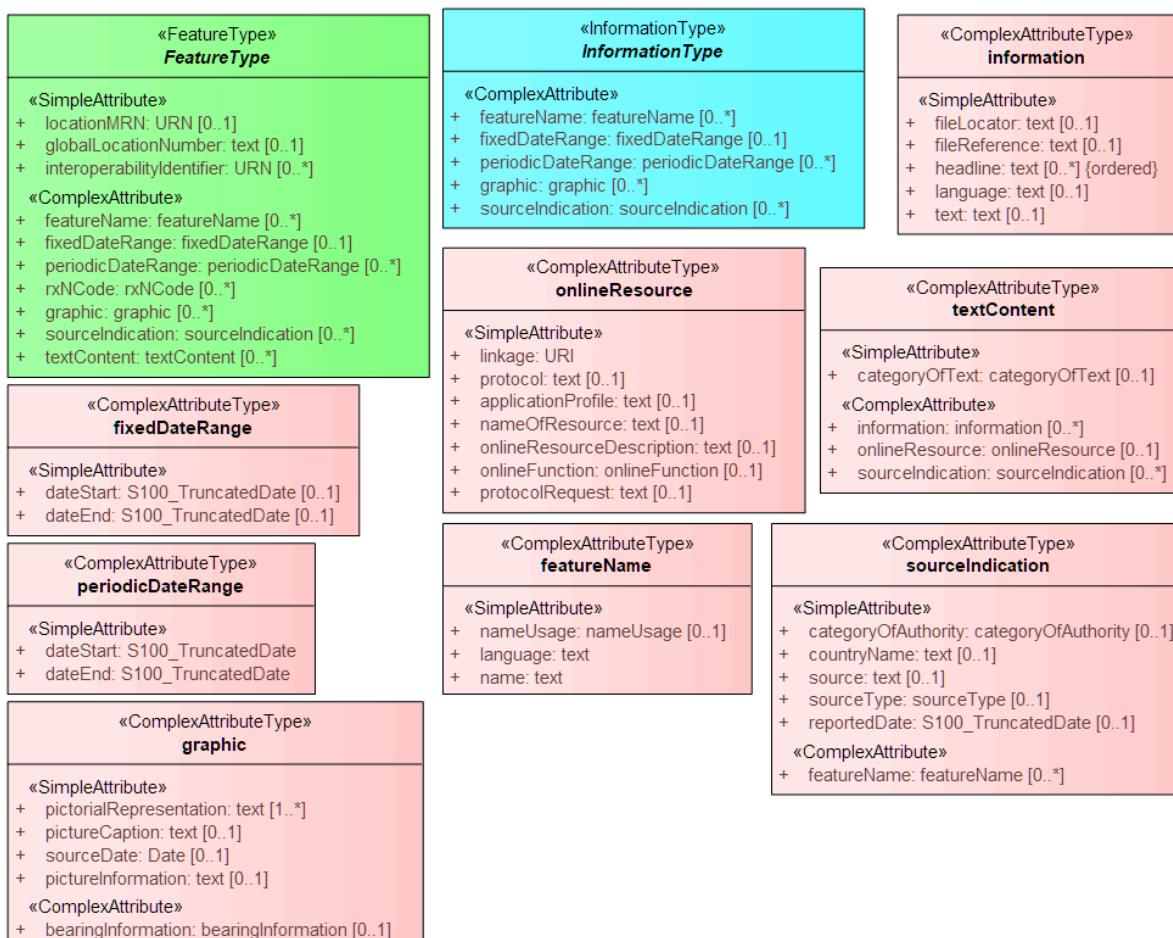


Figure 4-2 — Base classes in S-131

4.2.1.1 Overview of domain features and information types

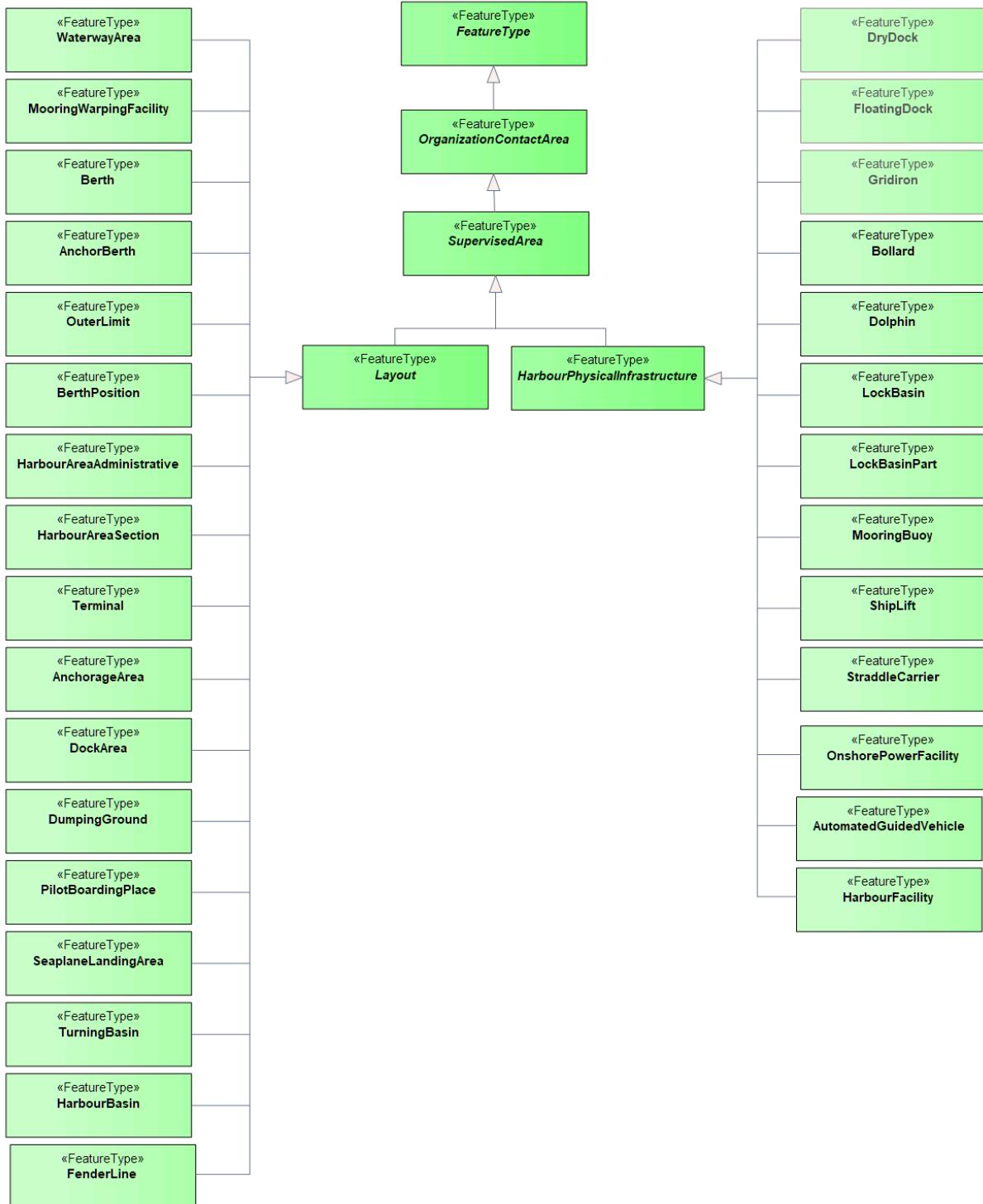
Marine Harbour Infrastructure data products include harbour facilities, port services and specially designated areas related to ship operations in ports. It does not include protected areas, obstructions

and other physical features, or natural conditions. The broad categories of geographic features and non-geographic information included in the S-131 domain are:

- Harbour layout, including the locations of terminals and berths, and contact information for terminal operators.
- Port services and related features such as waste reception facilities, supplies, fuel, and repair facilities.
- Supporting infrastructure such as the nature of nearby transportation.
- The locations of infrastructure such as dry docks and syncrolifts.
- Specially designated locations relating to manoeuvres, such as fairways and turning basins.

The geographic features are divided into “layout” and “physical infrastructure” classes, which are used as abstract generalizations of the domain feature classes. In addition, the **OrganizationContactArea/SupervisedArea** hierarchy used in other domain models for nautical publications are used as upper-level generalizations. [Figure 4-3](#) depicts the hierarchy of domain feature classes.

Geographic features use spatial types defined in the geometry package for spatial attributes. Datasets comprised of S-131 features are described by metadata as defined in the S-131 metadata package.

**Figure 4-3 — Overview of S-131 domain feature classes**

Information types model chunks of information associated to feature types. Information types may be associated to other information types or referenced by associations from feature types. The information types used in S-131 are depicted in [Figure 4-4](#).

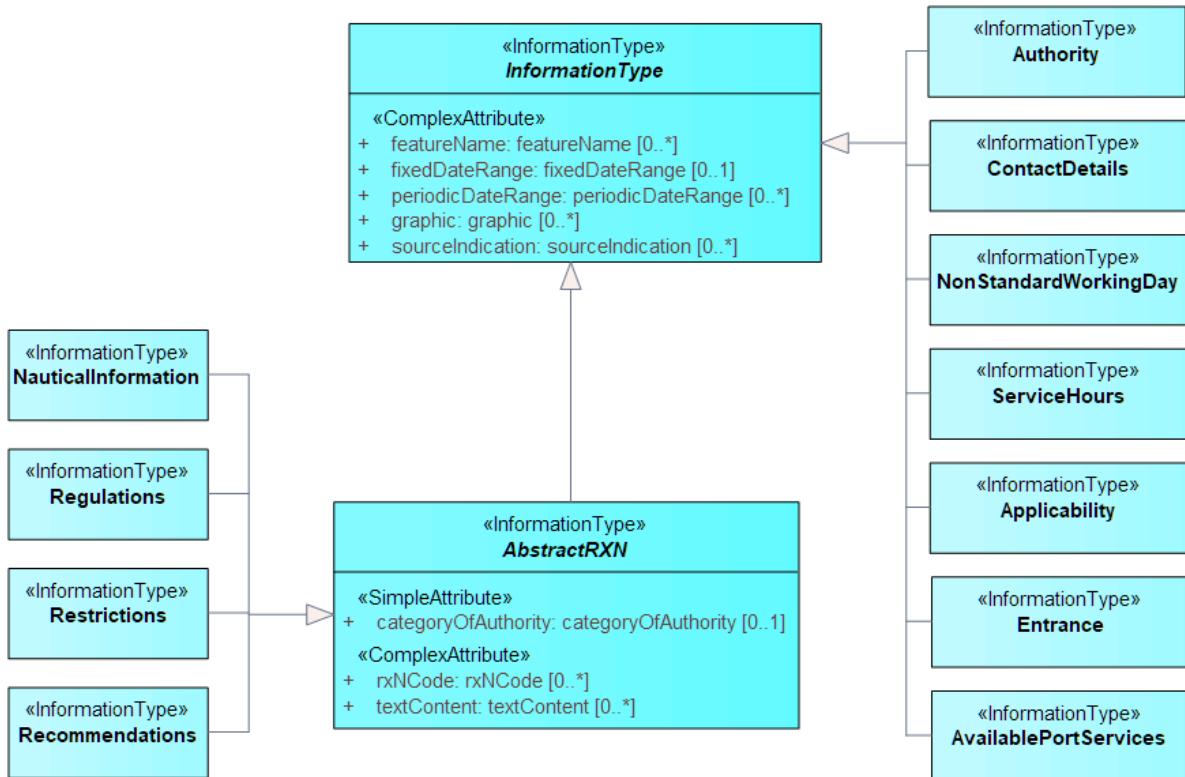


Figure 4-4 — Information types

The abstract class **FeatureType** is an abstract class from which the geographic feature classes in the application schema are derived. (Meta- and cartographic feature classes do not derive from it.) **FeatureType** has attributes for fixed and periodic date ranges indicating the effective dates of the feature, name of the feature, source information, types of regulations, and a *textContent* attribute that allows text notes or references to be provided for individual feature instances where appropriate. The attributes defined in **FeatureType** are inherited by all S-131 geographic feature types. All the attributes in **FeatureType** are optional. A derived class may impose additional constraints, which will be described in the definition of the derived class or the S-131 DCEG. [Figure 4-5](#) depicts **FeatureType** and its attributes.

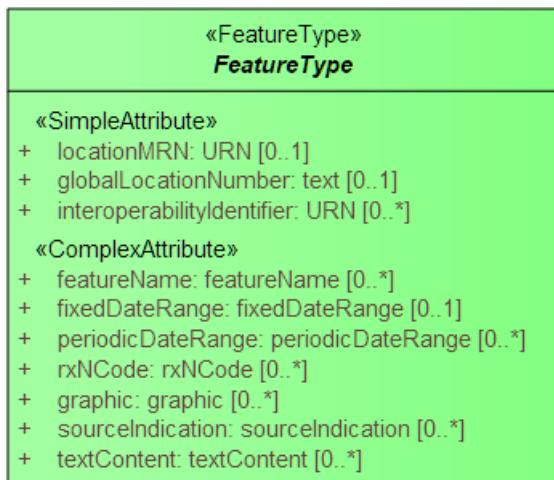


Figure 4-5 — The root class FeatureType

The abstract class **InformationType** is an abstract class from which all the information type classes in the S-131 domain model (except **SpatialQuality**) are derived. **InformationType** has attributes for fixed and periodic date ranges, name associated with the individual information object if any, source information, and a *textContent* attribute that allows text notes or references to be provided for individual instances

where appropriate. The attributes defined in **InformationType** are inherited by all S-131 information type classes. All the attributes of **InformationType** are optional. A derived class may impose additional constraints, which will be described in the definition of the derived class or in the S-131 DCEG. [Figure 4-6](#) depicts **InformationType** and its attributes.

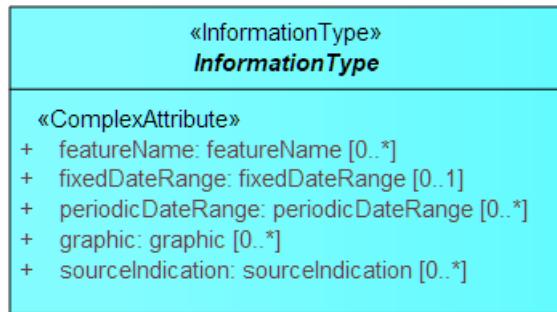


Figure 4-6 — The root class **InformationType**

4.2.1.2 Layout

Layout features describe the layout of the harbour area. They include terminal, mooring facilities, special areas within the harbour, berths, designation of the positioning of specific berths along a wharf or quay, dock areas, and a **HarbourAreaSection** feature for subdividing harbour areas into sub-sections.

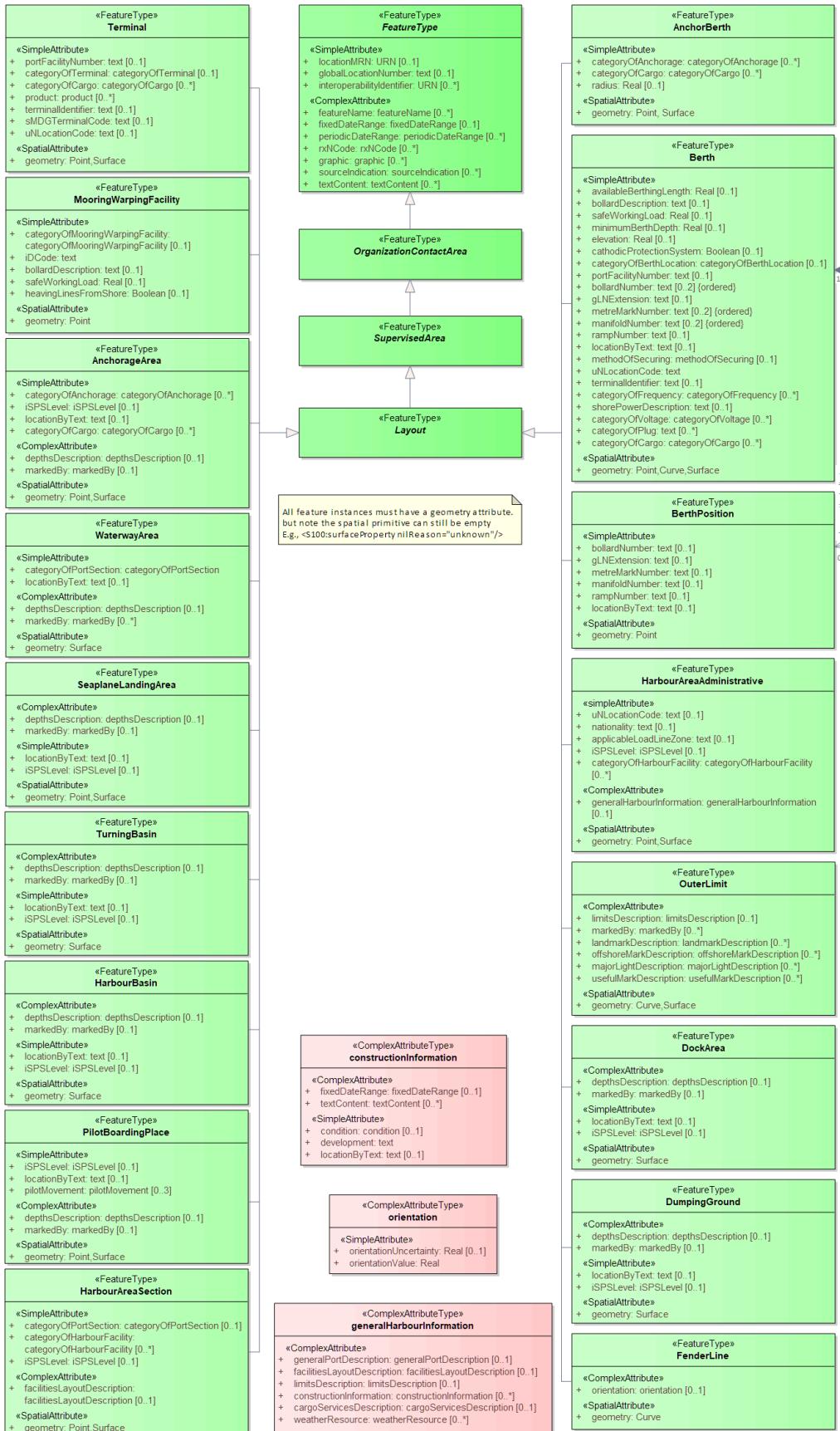


Figure 4-7 — Layout features

4.2.1.3 Physical Infrastructure

Physical infrastructure features include drydock and floating dock facilities, locks, bollards, dolphins, ship lifts, gridirons, and straddle carriers. The features are depicted in [Figure 4-8](#).

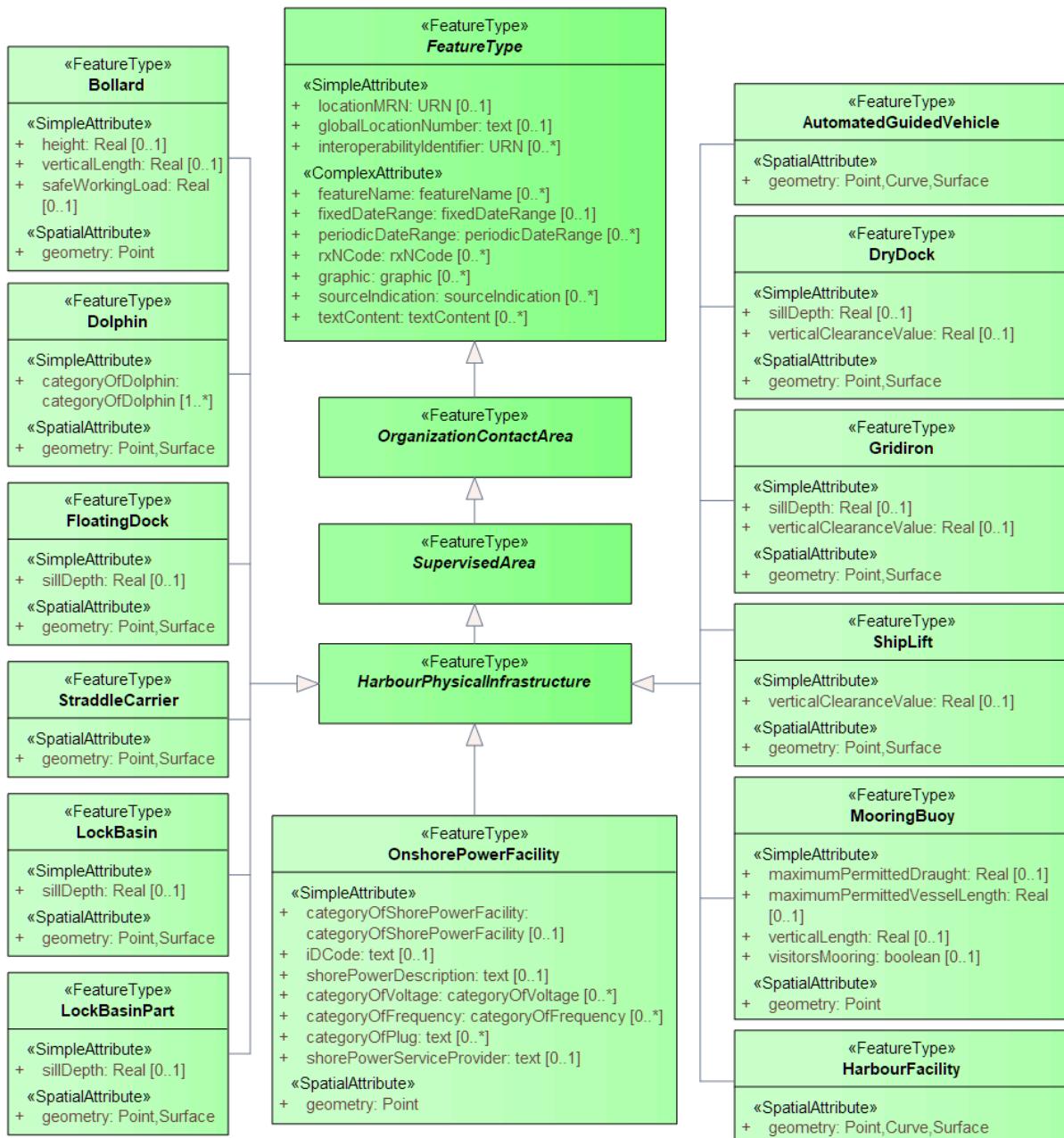


Figure 4-8 — Physical Infrastructure features

4.2.1.4 Services

Information about the services available in specific areas is modelled by means of an information association from the feature to the **AvailablePortServices** information type. This relationship is depicted in [Figure 4-9](#). This type contains attributes for encoding various types of services. Examples of the service enumerations are depicted in [Figure 4-10](#).

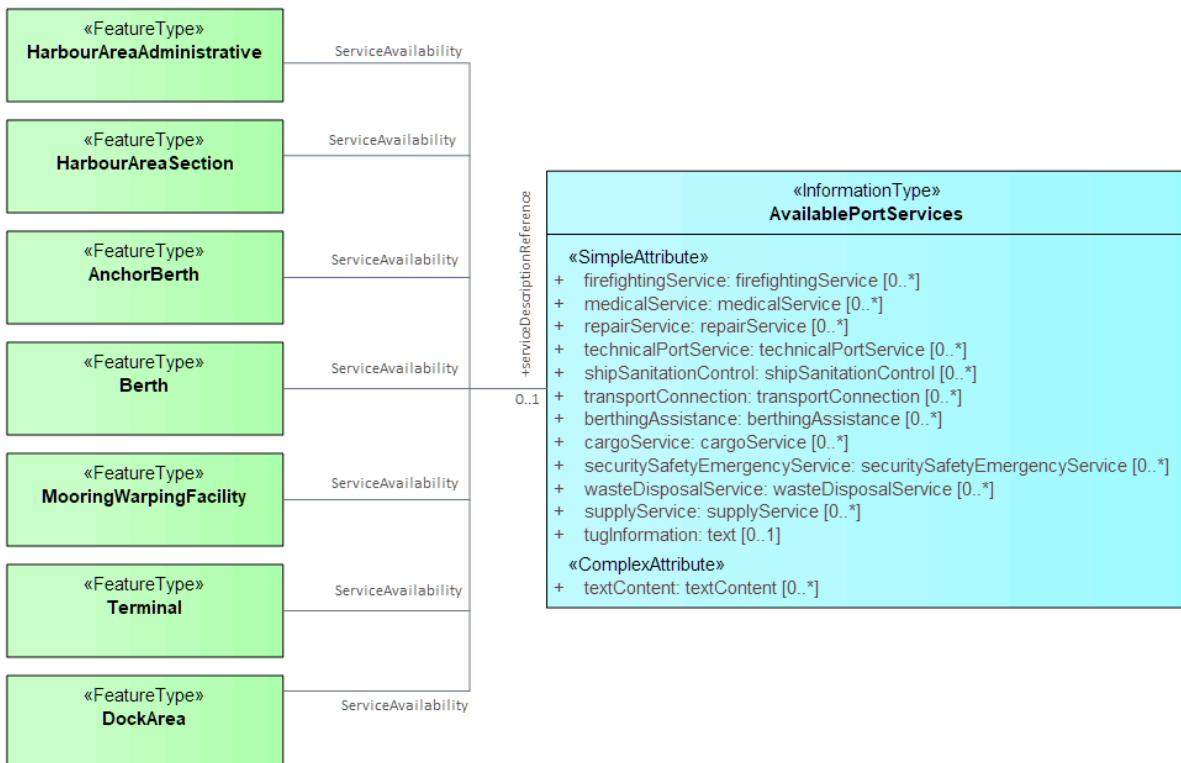


Figure 4-9 — Port Services

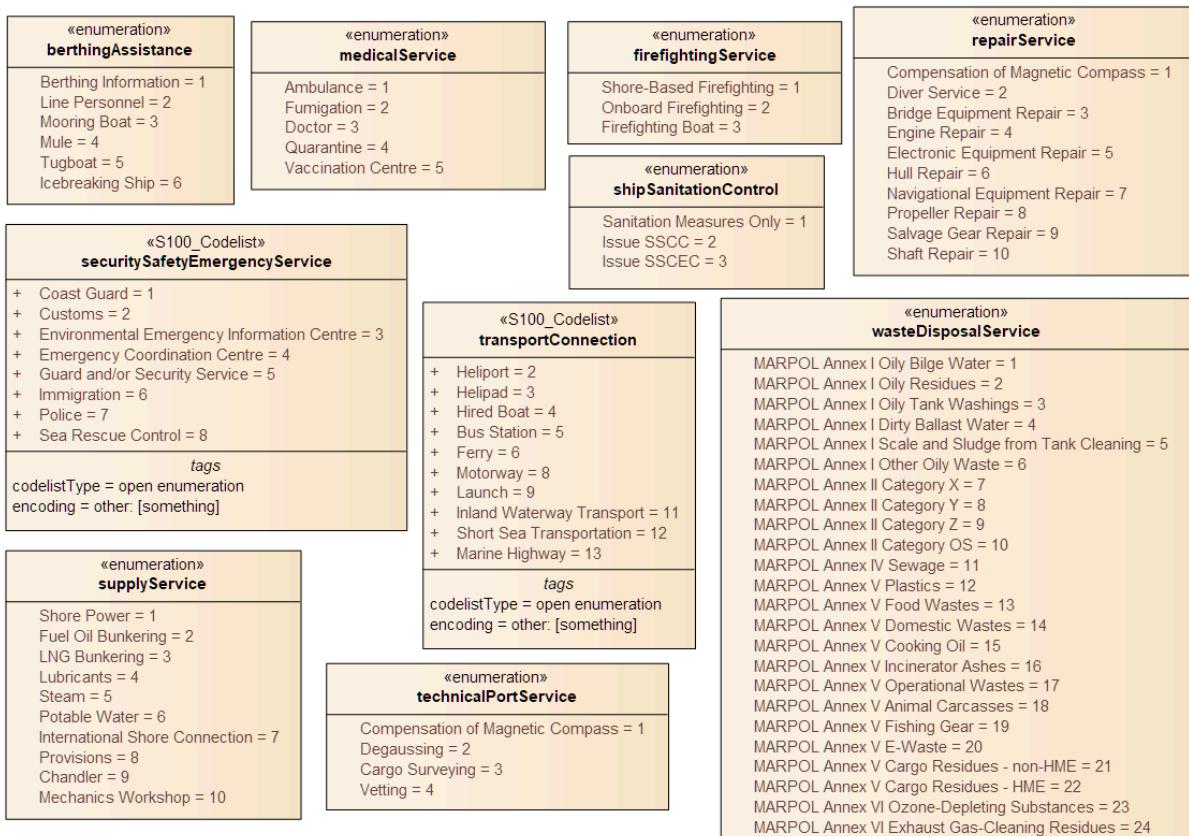


Figure 4-10 — Service Enumerations and Codelists

4.2.1.5 Regulations

There are three main information types which represent regulations, restrictions, and recommendations, respectively, and a fourth information type for general or unclassifiable information.

- The **Regulations** class represents information derived from port regulations, rules made by terminal operators, laws, national shipping regulations, navigation rules, etc.
- Class **Restrictions** is intended for restrictions that are not derived from regulatory sources.
- Class **Recommendations** is intended for information that is recommendatory in nature; in S-131 this may be recommendations for the orientation of vessels relative to the wharf while docking and similar pieces of information that are either voluntary or have not been issued as formal rules by the port authority or terminal operator.

The fourth class, **NauticalInformation**, is intended for general notes or other information that cannot be categorized as one of the other three classes.

These information types all inherit the attributes of their immediate abstract superclass **AbstractRxN**, which provides attributes *textContent* and *graphic* for textual and pictorial material respectively. The sub-attributes of its complex attribute *rxnCode* allow optional classification of the material encoded in *textContent/graphic* according to the type of material and the kind of nautical activity affected by it. They also inherit the attributes of abstract superclass **InformationType**, which allows encoding of the effective and expiry dates, if any, and the source of information, if it is necessary to encode that data.

These classes are intended primarily for encoding textual information, such as that which derives from textual source material such as port handbooks, national or local laws or official publications.

The use of these information types to associate regulatory and other information to individual features is described elsewhere (clause 4.2.1.8). [Figure 4-11](#) depicts the **Regulations**, **Restrictions**, **Recommendations**, and **NauticalInformation** classes, their class hierarchy, and the attributes of their generalizations **AbstractRxN** and **InformationType** (which are inherited by the classes).

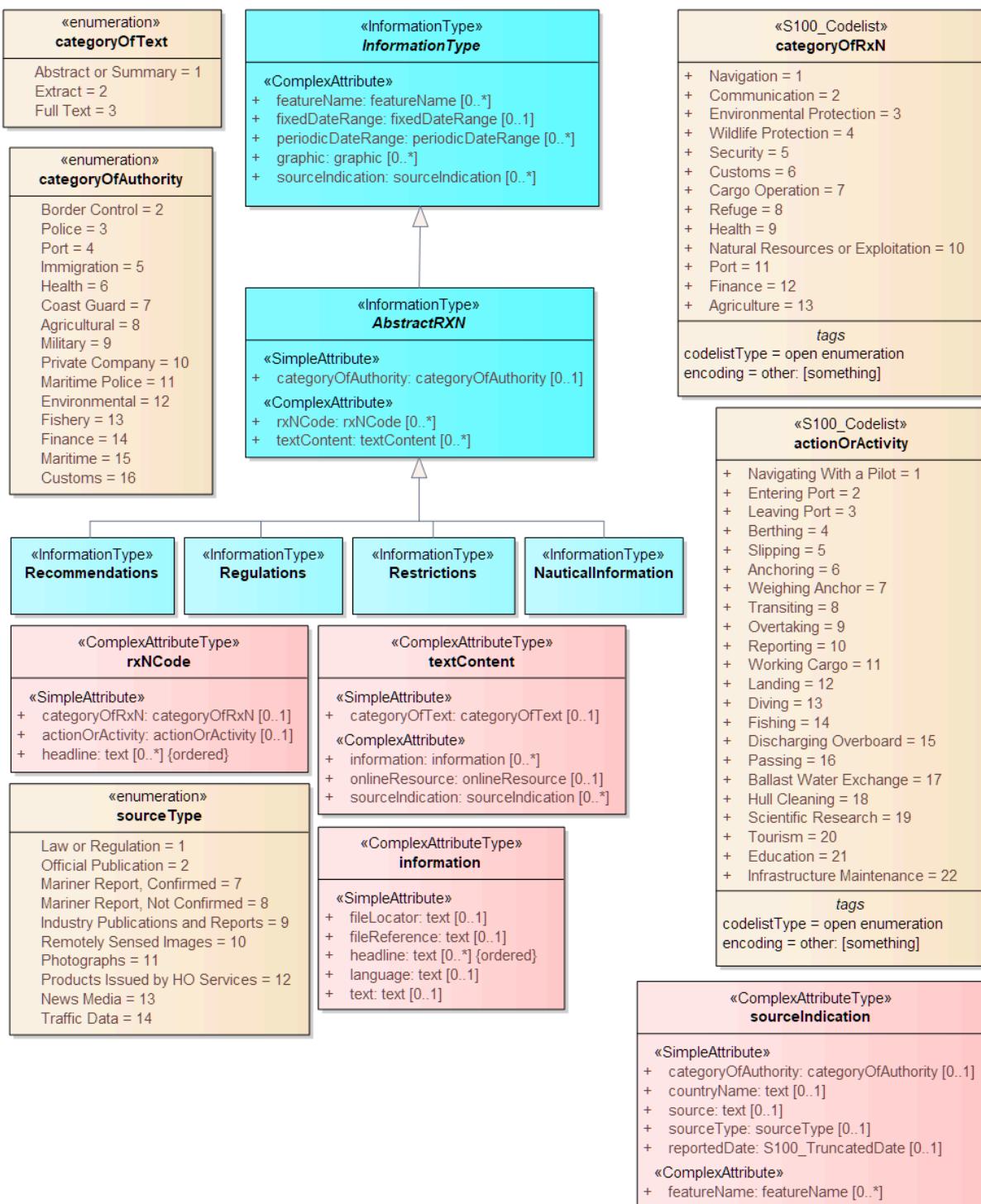
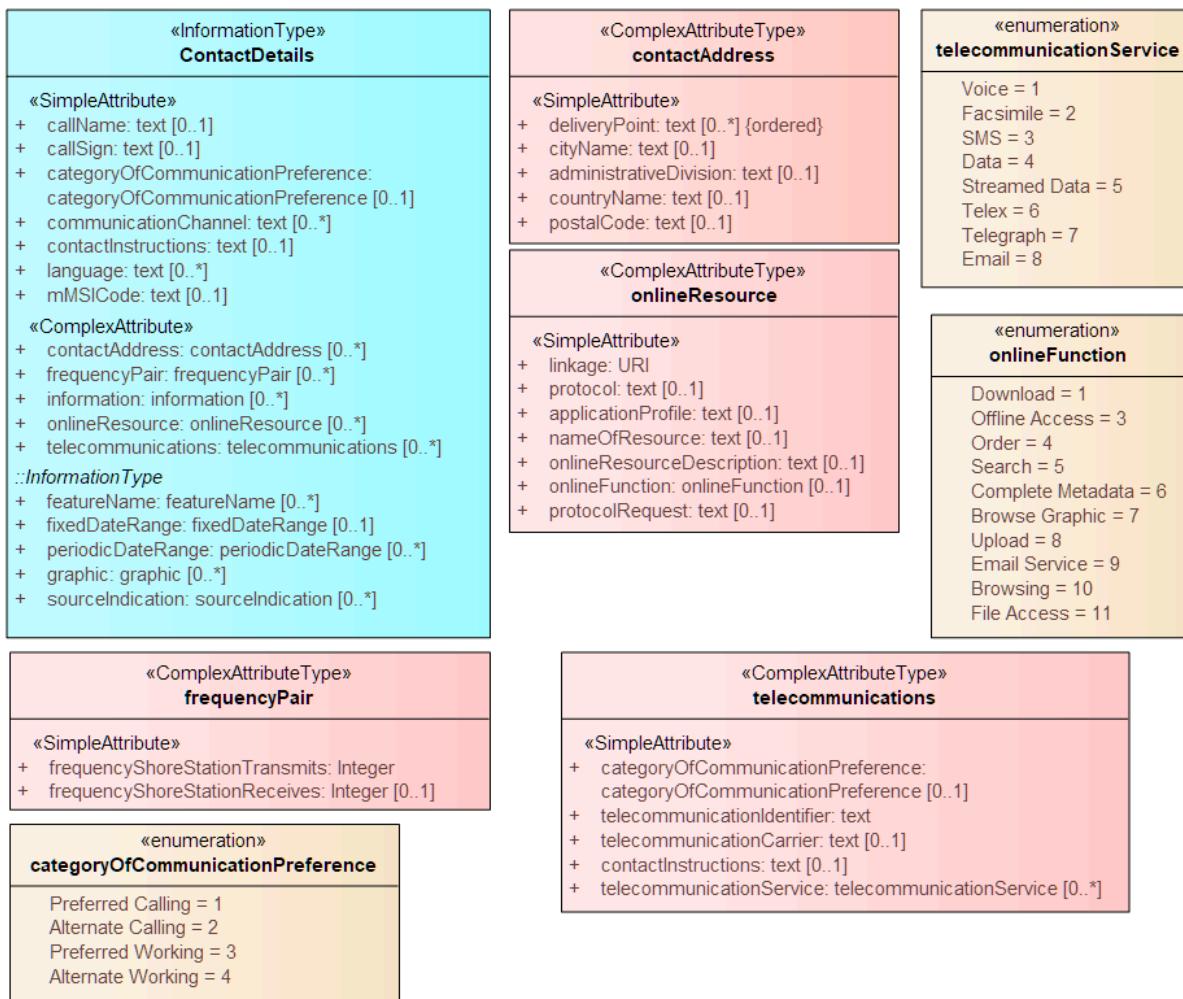


Figure 4-11 — Regulations and other information types for primarily textual information

4.2.1.6 Contact information

The detailed model of contact information is shown in [Figure 4-12](#) below.

**Figure 4-12 — Contact information**

Contact information can be associated to an instance of an **Authority** information type as well as to any feature that is a subtype of **OrganizationContactArea**, which means any S-131 geographic feature (meta and cartographic features do not allow this association). [Figure 4-13](#) shows the associations to **ContactInformation**.

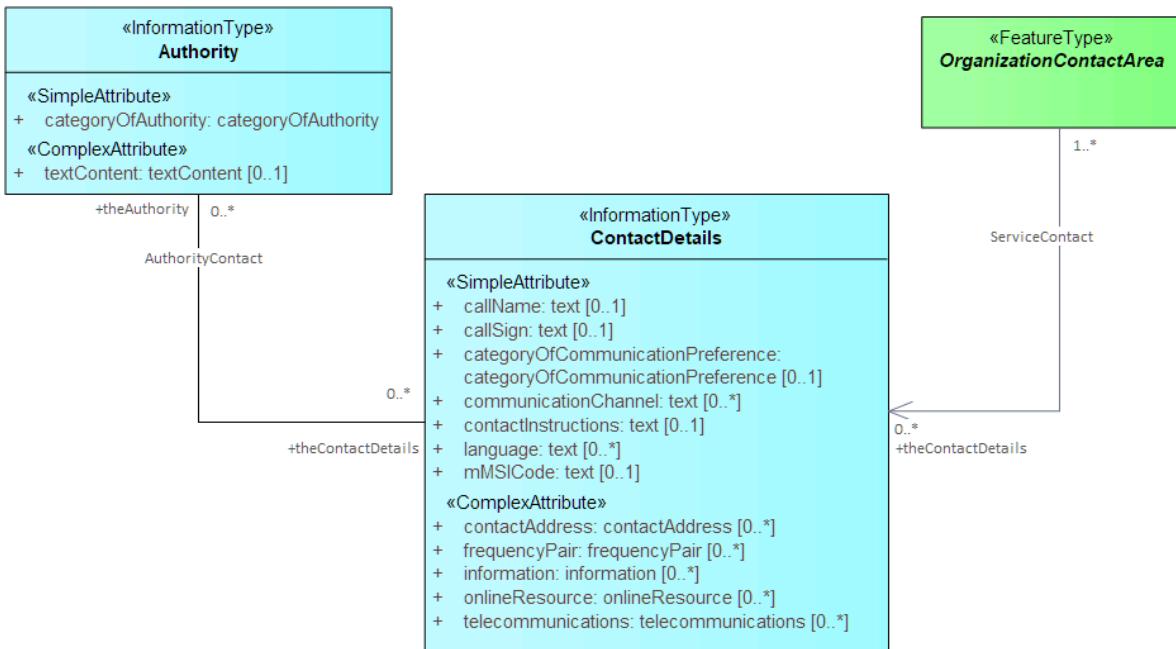


Figure 4-13 — Associations to contact information

4.2.1.7 Supervising organizations and their service hours

The **SupervisedArea** class models areas which may have an associated organization (government or private) that exercises some kind of control or supervision over the area.

Operating schedules and business hours of organizations are modelled by associating the **ServiceHours** class to an **Authority**. The **ServiceHours** class is a container for the complex attribute describing daily schedules for different weekdays (*scheduleByDayOfWeek*). This complex attribute contains another complex attribute for time intervals and the days to which they apply, and category sub-attribute to model whether the schedule describes opening hours, closures, etc. Exceptions to the schedule such as fixed or movable holidays are modelled by a **NonStandardWorkingDay** class with attributes allowing indication of the dates or days which are holidays or exceptions.

Working times and schedules for particular features are modelled by an analogous association from the feature object (association **LocationHours**). When a **ServiceHours** is thus linked to a service feature, the service hour information applies to the feature as a whole (e.g., all services for a **Terminal**). Note that since working hours do not apply to all features in the model, the associations are to individual features instead of abstract supertypes.

Working times of 24 hours/day may be explicitly encoded (from 00:00:00 to 24:00:00 hrs., in accordance with ISO 8601 conventions for midnight at the beginning and end of a day).

The model for both kinds of schedules is shown in [Figure 4-14](#).

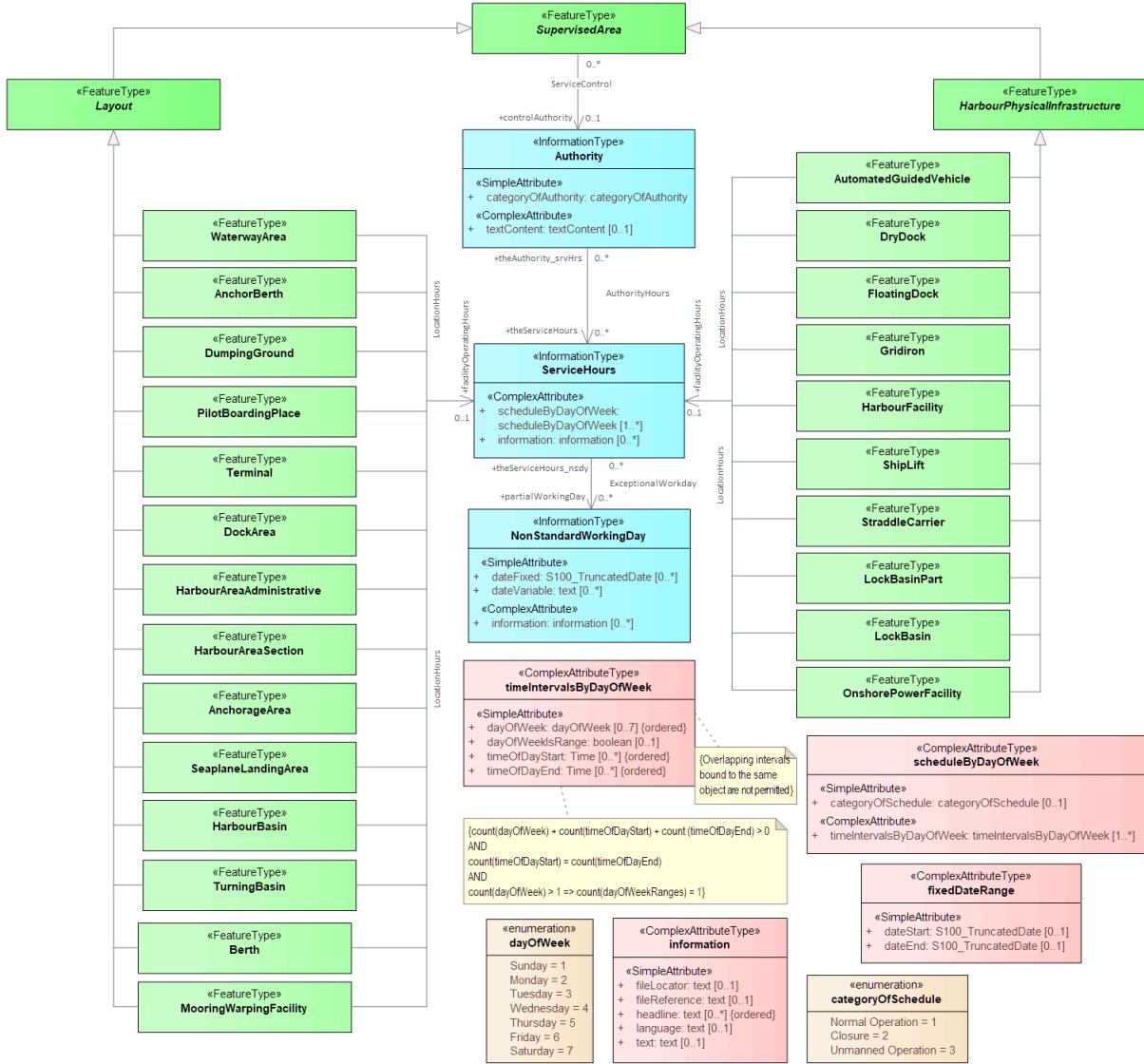


Figure 4-14 — Working times and schedules

The authority should be encoded only if its presence in the dataset conveys information that is useful to the end user. In S-131 this is expected to be the general case, but there may be exceptions, such as when the authority is open for business but a particular location under its jurisdiction is closed at certain times of day.

Since **Authority** also has an information association to **ContactDetails** (Figure 4-13), it is in principle possible to link a location to both an **Authority** and **ContactDetails** as well as linking the location to the same **ContactDetails**. Such linking is permissible but will generally be redundant and should, if possible, be avoided as unnecessary duplication. It may be done in situations where contact details for an operating authority are different from contact details for the service it operates.

Figure 4-14 also shows associations between service features and **Authority**. **Authority-ContactDetails** associations are omitted to reduce clutter.

4.2.1.8 Regulations applying in specific locations

The **AssociatedRxN** association between a feature type and a **Regulations**, **Restrictions**, **Recommendations**, or **NauticalInformation** object (see Figure 4-15) indicates that the Regulation, etc., is applicable within the associated feature. If it is necessary to identify an authority or organization related to a particular regulation (restriction, etc.) object, this may be done using the **RelatedOrganisation** association between **Regulations**, etc., and an **Authority** object. This should be included only when the connection to the **Authority** conveys useful information to the end user—it is not intended to encode the issuing or controlling authority for every regulation. Note also that while **Authority** can be associated

to geographic features as well as **Regulations**, etc., encoding both associations is not mandatory even when the same **Authority** is associated to a service area as well as a **Regulations** object (or **NauticalInformation**, etc.).

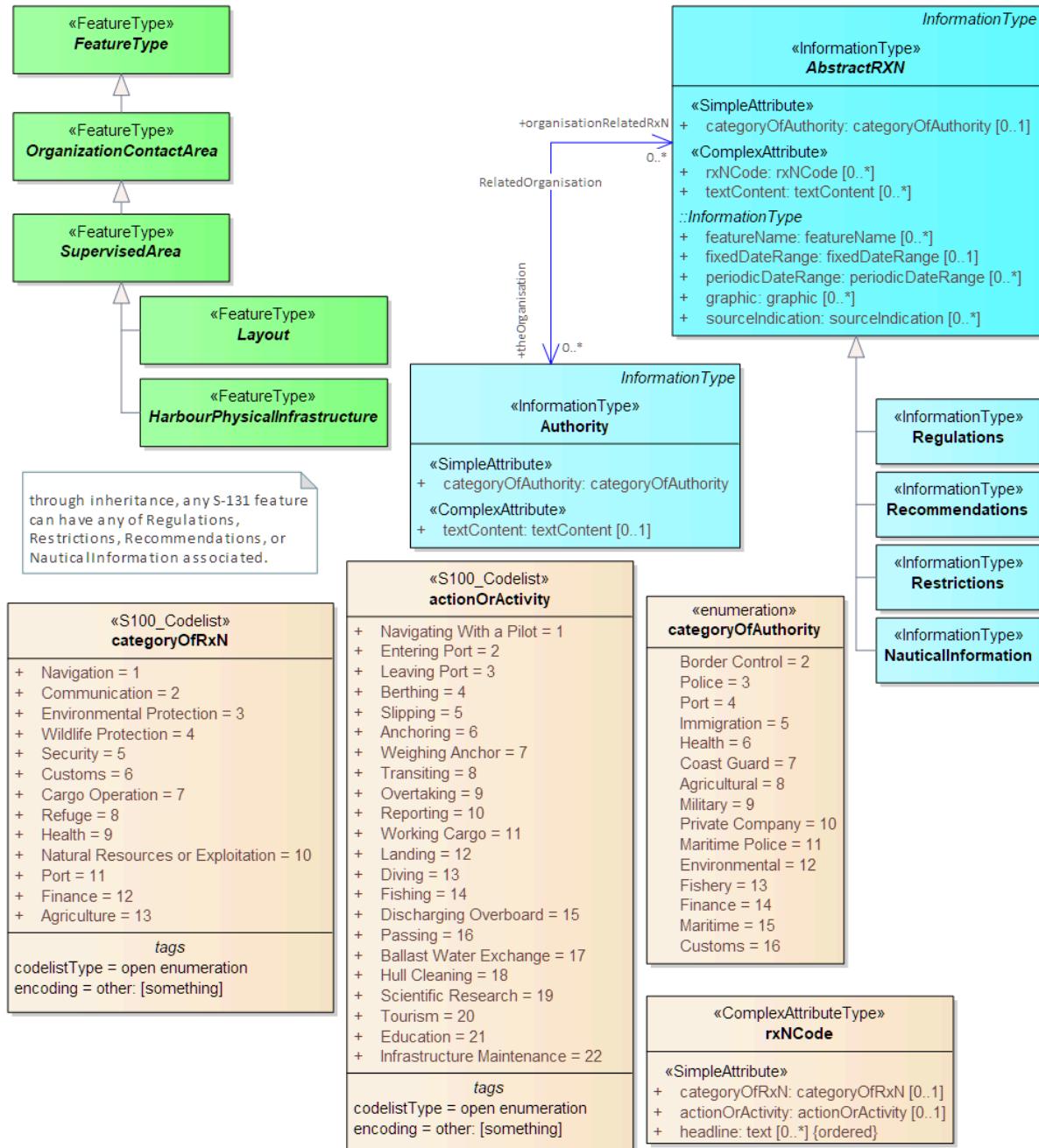


Figure 4-15 — Regulations, etc., applying to specific features

4.2.1.9 Regulations applying only to vessels with specific characteristics or cargoes

Certain regulations apply only to vessels of specified dimensions, types, or carrying specified cargo, etc.

This is modelled by first defining the relevant subset of vessels according to the dimension, type, cargo, etc., and then associating that subset to the appropriate feature or information type. The subset of vessels is modelled using the **Applicability** class, which contains attributes for the most common vessel characteristics used in nautical publications. These include measurements (length, beam, draught), type of cargo, displacement, etc. Constraints which cannot be modelled using the attributes of **Applicability** can be described in plain text in its *information* attribute.

Conditions relating to vessel dimensions are modelled by the complex attribute *vesselMeasurements*, which has sub-attributes for naming the dimension and indicating the limit (whether the condition applies to a vessel which exceeds or falls below the limit). For example, the combinations below describe the condition “length overall > 50 m” (Condition 1) and “length overall < 90 m” (Condition 2):

Table 4-1 — Conditions relating to vessel dimensions

	Condition 1	Condition 2	Condition 3
vesselCharacteristics	length overall	length overall	breadth
comparisonOperator	greater than	less than	greater than
vesselCharacteristicsValue	50	90	20
vesselCharacteristicsUnit	metre	metre	metre

The *logicalConnectives* attribute is used to indicate how to interpret the case where multiple conditions are encoded using attributes of measurements—whether the conditions described by condition attributes are cumulative (conjunctive, AND) or alternatives (disjunctive, OR). A *logicalConnectives*=AND combined with Conditions 1 and 2 above describes a vessel of length between 50 and 90 metres; *logicalConnectives*=OR combined with conditions 1 and 3 describes a vessel of length greater than 50 metres or beam greater than 20 metres.

This modelling cannot represent subsets defined by both AND and OR combinations of conditions, but it is always possible to convert such complex conditions into multiple combinations each using only AND ('conjunctive normal form') or OR ('disjunctive normal form'), and model the subset using more than one **Applicability** object. Multiple instances of **Applicability** associated to the same feature or information type are interpreted as alternatives (inclusive OR).

[Figure 4-16](#) depicts the classes and attributes that can be used to define subsets of vessels according to specified characteristics.

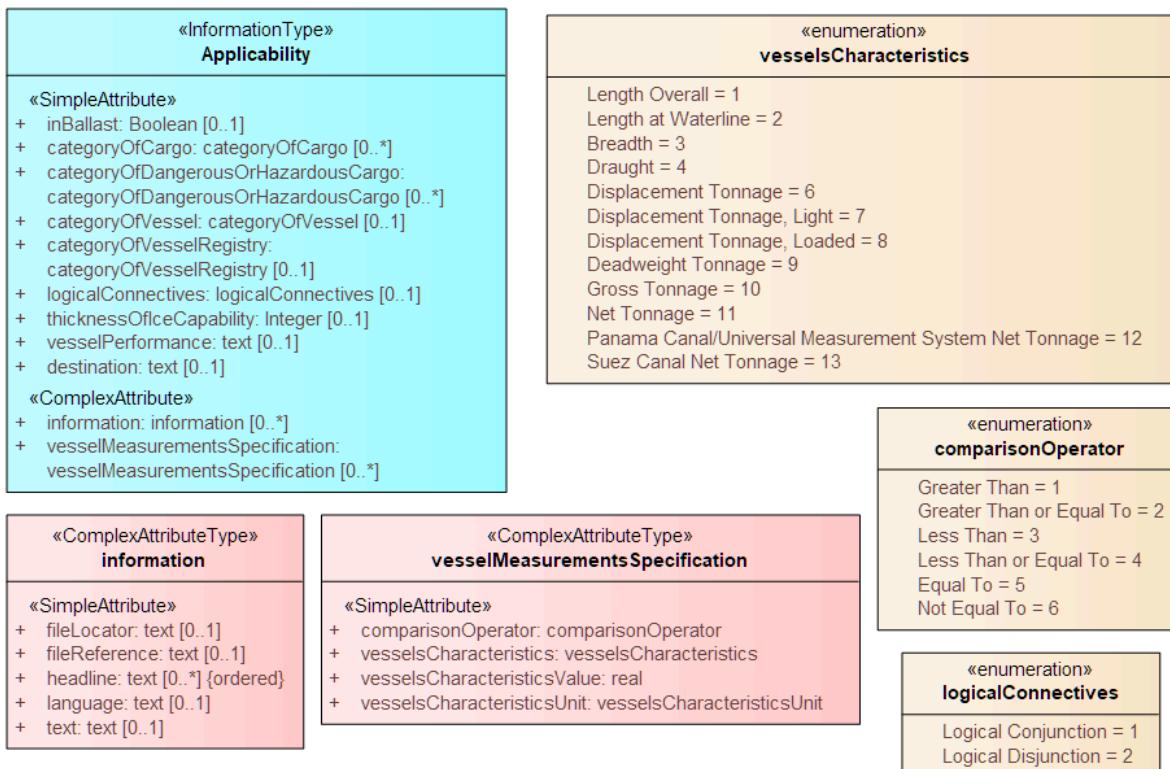


Figure 4-16 — Vessel subsets characterised by cargo, dimensions and capabilities

Given the relevant subset of vessels, it can be associated to the appropriate feature, regulation, or report by a **PermissionType**, or **InclusionType** association. These are association classes, whose single attribute models the nature of the relationship between the vessel subset and feature or information type. [Figure 4-17](#) depicts the use of vessel subsets in **PermissionType** or **InclusionType** associations.

The association classes **PermissionType** and **InclusionType** basically characterize the relationship. For example:

- 1) A specified set of vessels is COVERED by a regulation and another set of vessels is EXEMPT from the regulation.
 - 2) Vessels with specified cargo and dimensions MUST use a specified berth, vessels of smaller dimensions are RECOMMENDED to use the berth, and naval transports are EXEMPT from using the berth.

“COVERED” and “EXEMPT” are different kinds of relationship between different subsets of vessels characterized by different dimensional limits, etc., and a given regulation.

“MUST use”, “RECOMMENDED to use”, and “EXEMPT from use” are relationships between different subsets of vessels characterized by different dimensional limits, etc., and a given feature or service.

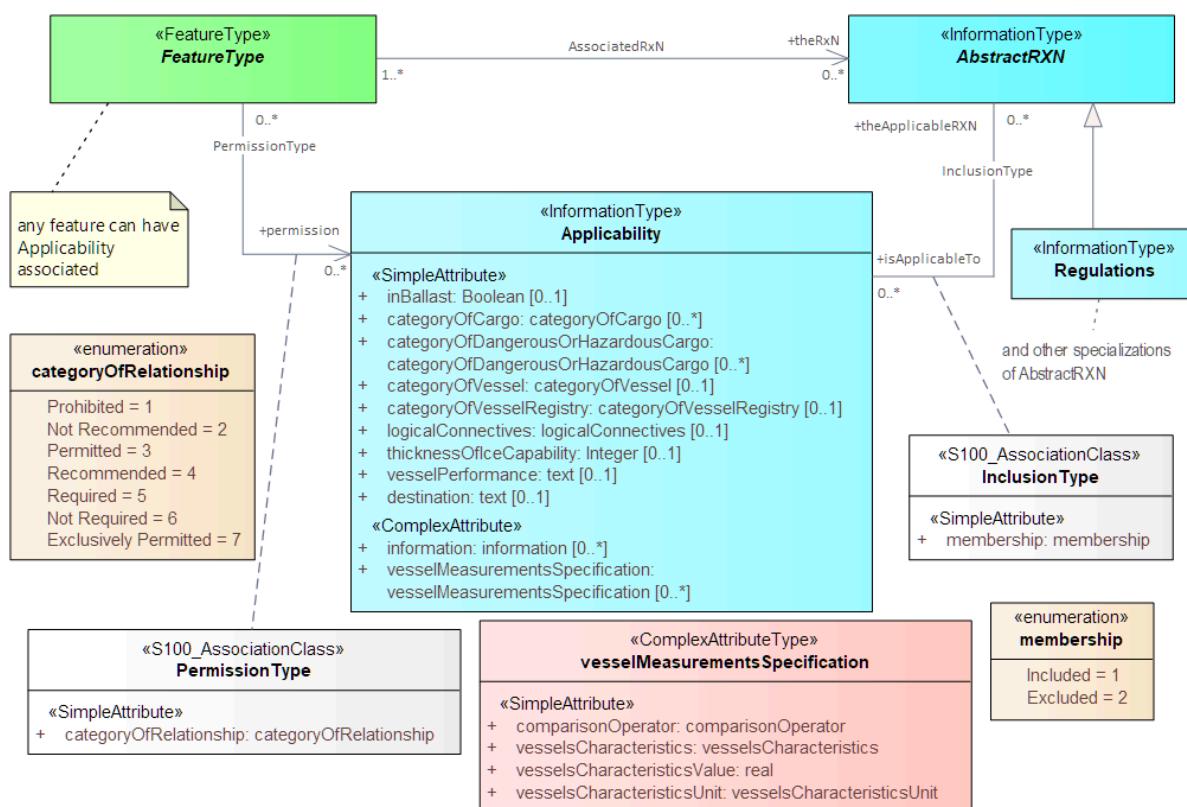


Figure 4-17 — Applicability of rules, etc., to vessel categories

PermissionType links a feature to an **Applicability**, and models a requirement, recommendation or prohibition on entry into a feature, by the specified subset of vessels.

Inclusion links a **Regulation**, **Recommendation**, **Restriction**, or **NauticalInformation** instance to a subset defined by an **Applicability** object, and indicates whether the content of the **Regulation**, etc., applies to the vessels (*membership=included*), or whether it explicitly does not apply (*membership=excluded*).

Informally:

- 1) **Applicability** describes the set of vessels: i.e., who
 - 2) **Regulations** provides the text of the regulation: i.e., what
 - 3) The association class **InclusionType** describes the relationship between who and what. That is, who "must (or can)" / "need not" do what.

Ans:-

- 4) A geographic feature defines a location or physical facility: i.e., where
- 5) The association class **PermissionType** describes the relationship between who and where. That is, who can / must / should / need not use (or sail) where.

4.2.1.10 Other uncategorized supplementary information

The domain model also provides a method for attaching to any feature or information type data in the form of a text note, graphic, or Internet reference which cannot be categorized using an appropriate feature or information type. This consists of defining a **NauticalInformation** object and referencing it from the feature or information type using the **AdditionalInformation** association. This method is intended to be a last resort and every effort should be made to use a more specific feature or information type to encode the information to be attached, including splitting the information in question across more than one type of feature or information object as needed and/or using the **AssociatedRxN** association instead of **AdditionalInformation**, wherever the nature of the content allows it. See [Figure 4-17](#).

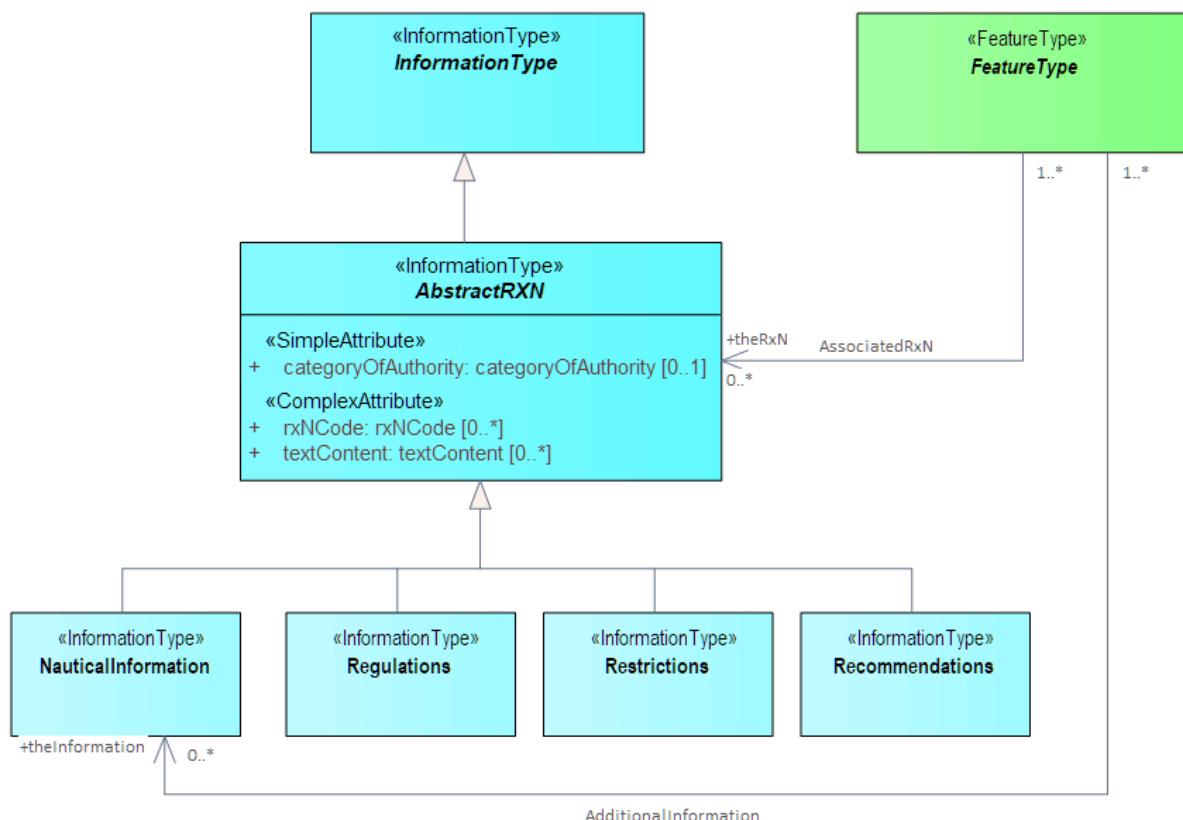


Figure 4-18 — Attachment of uncategorizable information to any feature or information type

4.2.1.11 “Wrapper” complex attributes

S-131 provides a general method for encoding some kinds of information using “wrapper” attributes that are basically a named type of text content. The information is encoded in narrative form in a *textContent* sub-attribute, which provides a general way to encode textual information. [Figure 4-19](#) depicts the wrapper attributes.

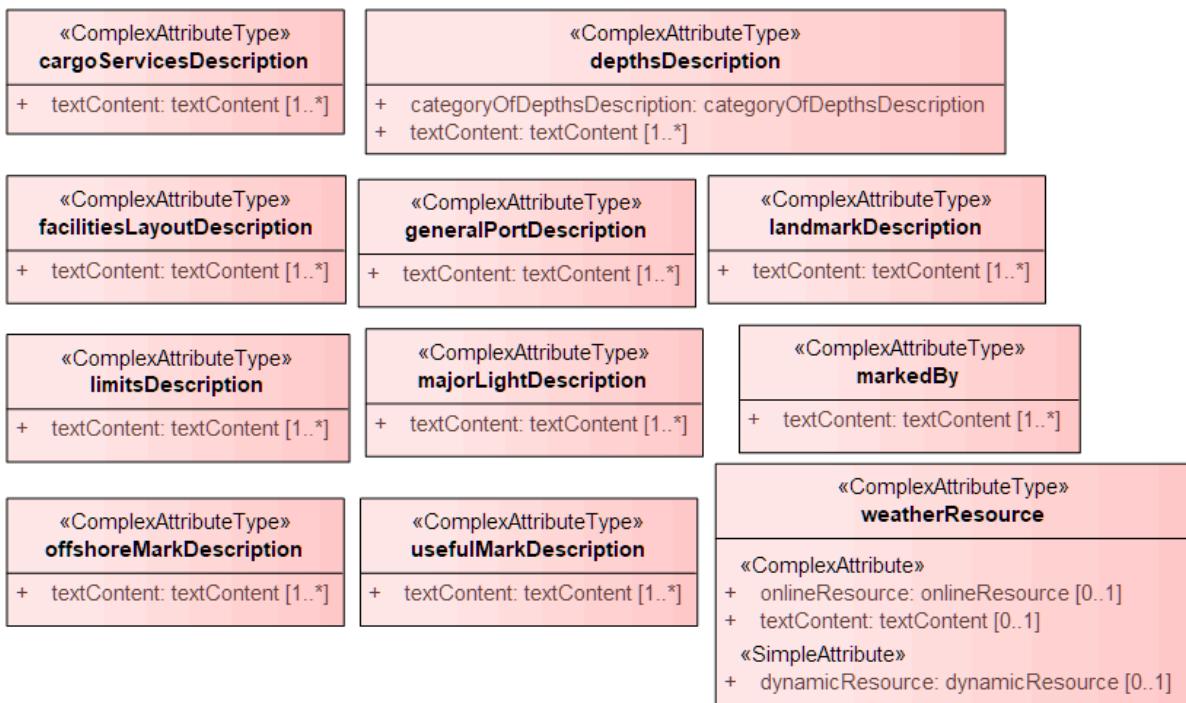


Figure 4-19 — Wrapper Attributes

4.2.1.12 Feature relationships

Feature relationships in S-131 are depicted in [Figure 4-20](#). The feature relationships can be generally characterized as follows:

HarbourAreaAdministrative is the main feature that covers the whole port area. It is subdivided into zero or more sections modelled by **HarbourAreaSection** features (the **LayoutDivision**) aggregation. **HarbourAreaSection** can be further subdivided into **WaterwayArea**, **Terminal**, **Berth**, **AnchorageArea**, **DockArea**, etc. The **Terminal** feature can also be subdivided into **Berth** features using the same association.

HarbourAreaSection can also be subdivided into further features of the same class (the **SubUnit** self-association).

Nominal positions of berths can be indicated by associating a **BerthPosition** feature to **Berth** using the **Demarcation** association.

Berth positions and Anchor berths can be linked to a mooring facility using the **PrimaryAuxiliaryFacility** association.

Physical infrastructure features in a **Terminal** or **HarbourAreaSection** feature should be linked to its container **Terminal** or **HarbourAreaSection** by an **Infrastructure** association. If there is an hierarchy of features containing the infrastructure only the feature at the lowest level of the hierarchy should be linked to the infrastructure feature.

The outer limit of the whole harbour area can be associated to **HarbourAreaAdministrative** feature using a **JurisdictionalLimit** association.

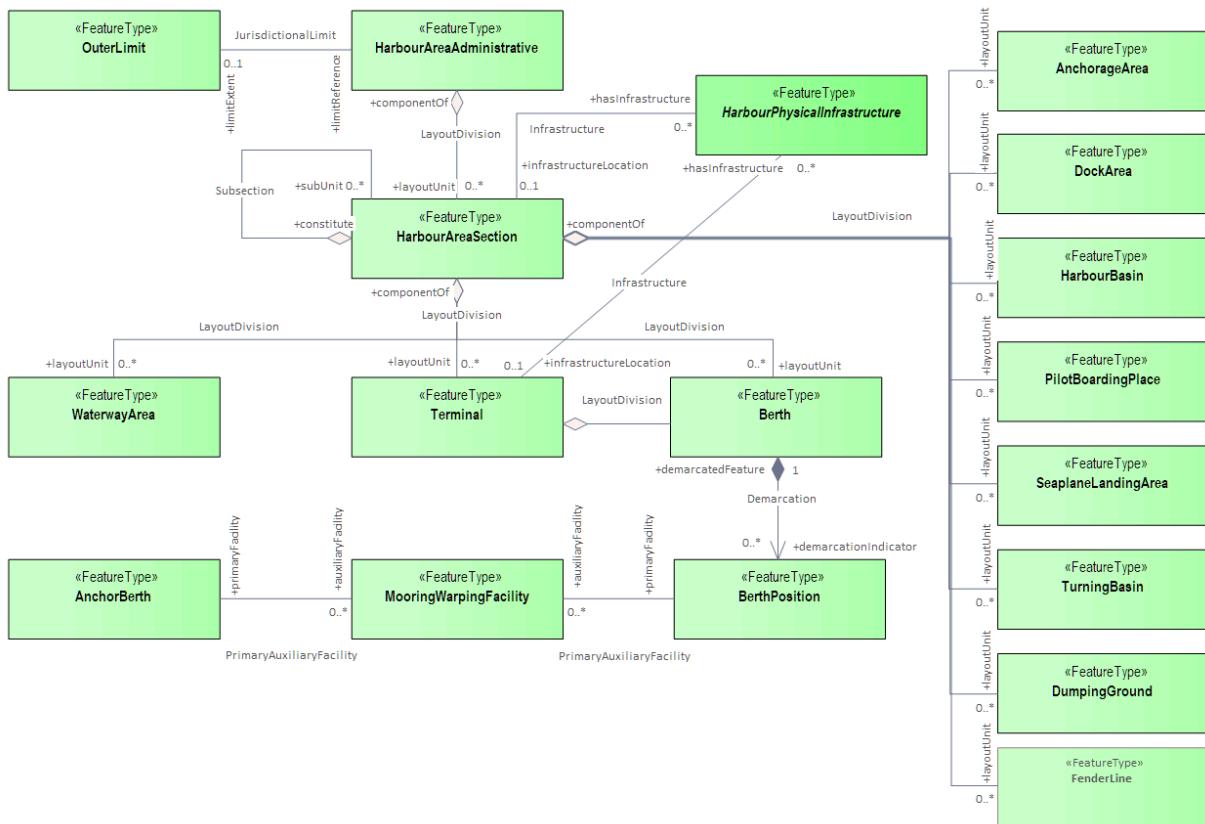


Figure 4-20 — Relationships between geographic features

4.2.2 Meta Features

S-131 provides four meta-features:

- **DataCoverage** for describing areas in the cell that are populated with data. If the cell must include distant areas that are not part of the port area, such areas will generally be excluded from the **DataCoverage** feature(s).
 - **QualityOfNonbathymetricData** for encoding quality information.
 - **SoundingDatum** and **VerticalDatum** for encoding information about the datums for depths and elevations respectively.

[Figure 4-21](#) depicts the meta-features and their attributes.

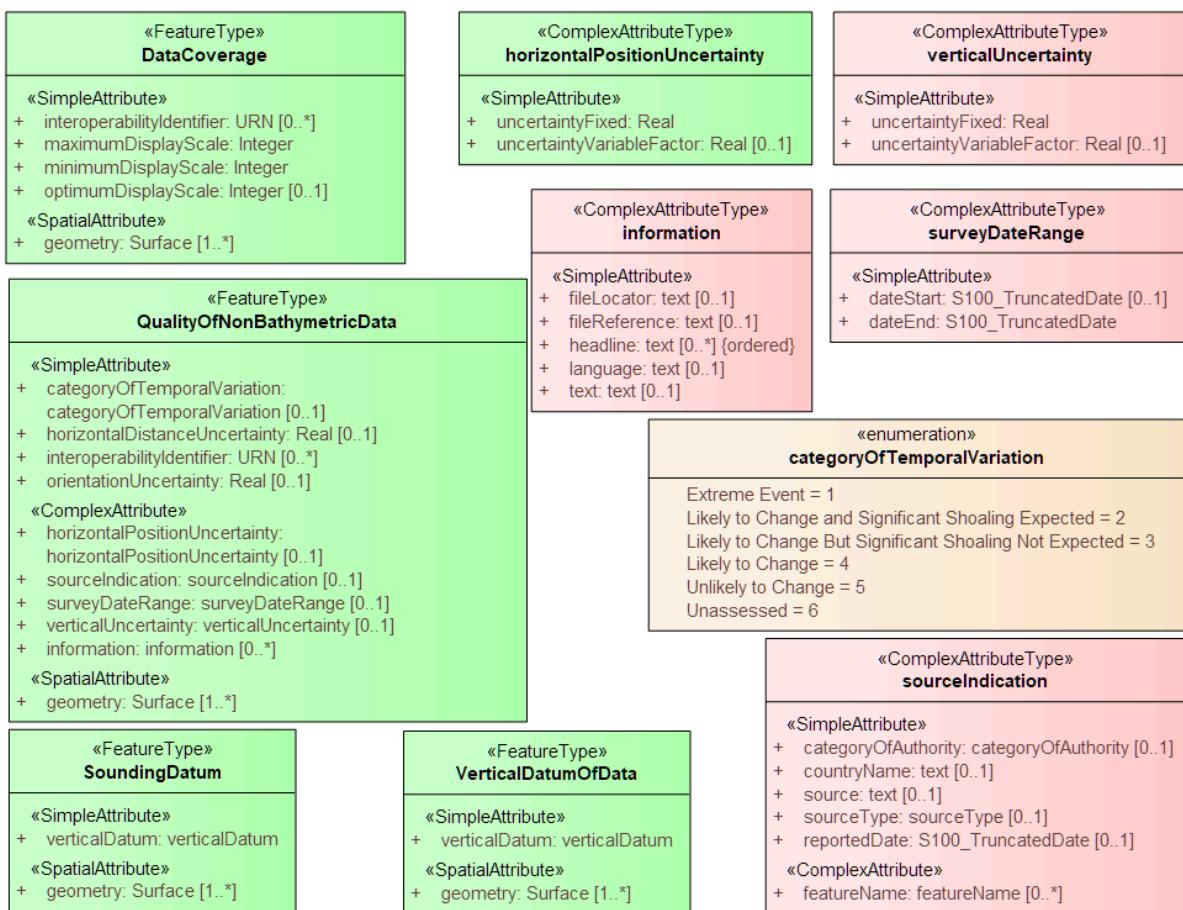
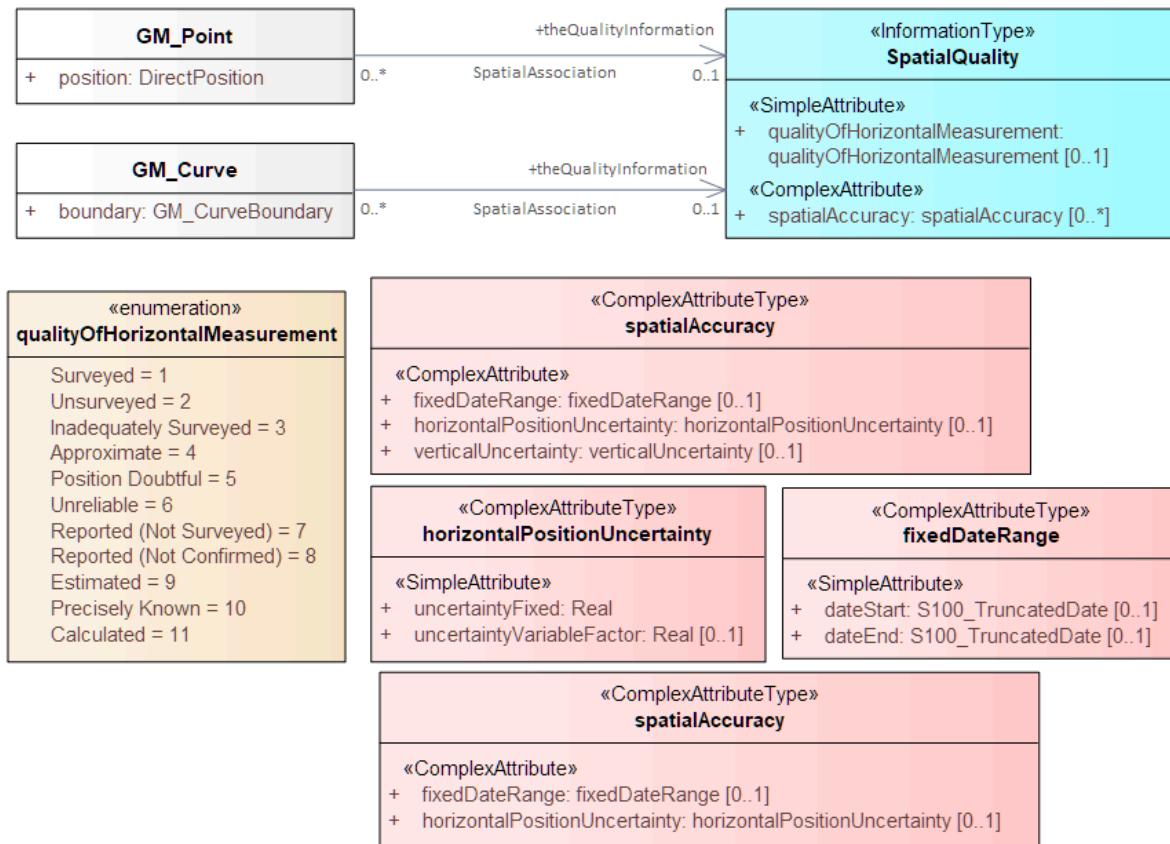


Figure 4-21 — Meta-feature classes

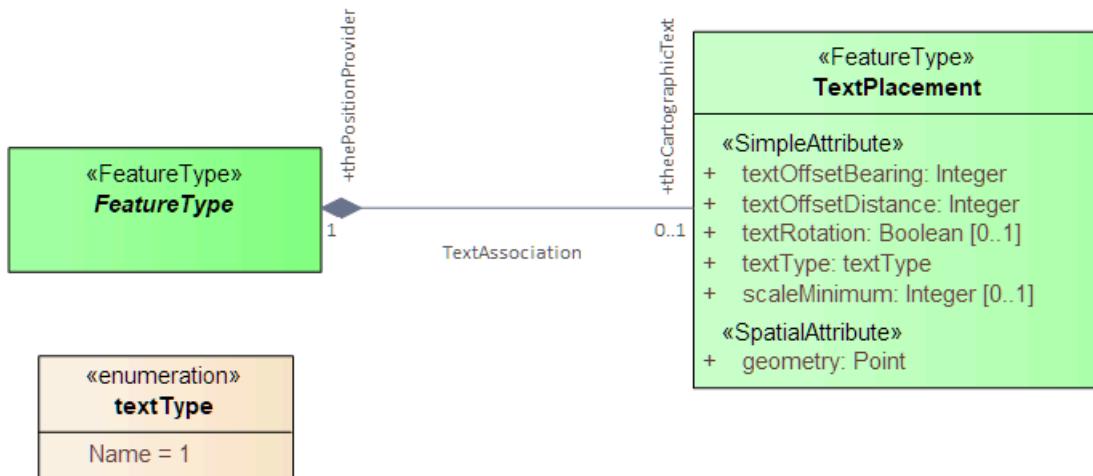
4.2.3 Spatial Quality Information Type

S-131 spatial quality of spatial primitives is encoded in the SpatialQuality information type, which is associated to spatial objects. The modelling is the same as in S-101. The attributes describe qualitative and quantitative horizontal quality. See [Figure 4-22](#).

**Figure 4-22 — Spatial Quality**

4.2.4 Cartographic Features

S-131 utilizes a single cartographic feature called TextPlacement that is to optimise text positioning, such as at smaller scales to prevent cluttering. This feature can be associated to any geographic feature and gives the location of a text string relative to the location of the feature. The modelling and use are the same as in S-101. See [Figure 4-23](#).

**Figure 4-23 — Text Placement**

5 Feature Catalogue

5.1 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-131 Feature Catalogue is available in an XML document which conforms to the S-100 XML Feature Catalogue Schema and can be downloaded from the IHO Geospatial Information Registry website (<https://registry.ihonet/>).

5.2 Feature types

Feature types contain descriptive attributes that characterize real-world entities. The word ‘feature’ may be used in one of two senses—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.

5.2.1 Geographic

Geographic (geo) feature types carry the descriptive characteristics of a real-world entity (a location or place on the surface of the Earth). In the context of hydrographic products, this includes the adjacent regions from the sea floor to elevations of landforms and structures above the Earth’s surface.

5.2.2 Meta

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

5.2.3 Cartographic

Cartographic features contain information about the cartographic representation (including text) of real world entities.

5.3 Information types

Information types define identifiable pieces of information in a dataset that can be shared using information associations. They have attributes but have no geometry.

5.3.1 Spatial quality

Spatial quality attributes are carried in an information class called **SpatialQuality**. Only points and curves can be associated with spatial quality. Currently no use case for associating surfaces with spatial quality attributes has been identified, therefore this is prohibited. Vertical uncertainty is prohibited for curves as this dimension is not supported by curves.

5.4 Feature and information relationships

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

An information relationship links instances of feature types or information types to instances of information types.

5.5 Attributes

S-131 defines attributes as either simple or complex.

5.5.1 Simple attributes

S-131 uses seven types of simple attributes; they are listed in the following Table:

Table 5-1 — Simple attribute types

Type	Definition
Boolean	A logical value, either 'True' or 'False'
Integer	An integer number
Real	A floating point number
Enumeration	One of a list of predefined values
Text or CharacterString	General text.
Date	<p>A date gives values for year, month and day according to the Gregorian Calendar. In XML formats including S-131, the XML Schema standard type should be used instead of the ISO 8601 basic representation (which is not a standard type in XML).</p> <p>EXAMPLE: 1998-09-18</p>
Truncated Date	<p>A S100_TruncatedDate allows a date or partial date to be given. At least one of the year/month/day components must be present. Since S-131 uses XML formats for both dataset and metadata, the XML encoding of truncated dates must be used (i.e., the ISO 8601 basic format is not used in S-131).</p> <p>Components:</p> <ul style="list-style-type: none"> YYYY Year integer between 0000 and 9999 MM Month integer between 01 — 12 (inclusive) DD Day integer between 01 and 28, 29, 30, or 31 (inclusive), consistent with year and month values if these are specified. <p>This type can be used to encode recurring instants (see S-100 Part 3, clause 3-8).</p> <p>EXAMPLE: The appropriate XML Schema type should be used: --12-17 representing 17 December of any year (conforming to the XML type (gMonthDay). S-100 Part 10b provides further details about encoding in GML datasets.</p>
Time	<p>A 24-hour time, it may contain a time zone. Since S-131 uses XML formats for both datasets and metadata, the XML encoding must be used.</p> <p>In XML formats (including S-131), the XML Schema standard type should be used instead of the ISO 8601 basic representation (which is not a standard type in XML).</p> <p>EXAMPLE: 18:30:59Z (local time in UTC); 18:30:59+01:00 (local time with given offset); 18:30:59 (local time without an offset to UTC).</p>
Codelist	A type of flexible enumeration. A code list type is a list of literals which may be extended only in conformance with specified rules.
URI	<p>A uniform resource identifier as defined in RFC 3986. Character encoding of a URI shall follow the syntax rules defined in RFC 3986.</p> <p>EXAMPLE: http://registry.oho.int</p>
URL	<p>A uniform resource locator (URL) is a URI that provides a means of locating the resource by describing its primary access mechanism (RFC 3986).</p> <p>EXAMPLE: http://registry.oho.int</p>
URN	<p>A persistent, location-independent, resource identifier that follows the syntax and semantics for URNs specified in RFC 2141.</p> <p>EXAMPLE: urn:oho:s101:1:0:0:AnchorageArea</p>

5.5.2 Complex attributes

Complex attributes are aggregations of other attributes that are either simple or complex. The aggregation is defined by means of attribute bindings. Bindings of complex attributes are represented in the S-131 UML diagrams by a local attribute ([Figure 5-1, HarbourAreaAdministrative](#) /

generalHarbourInformation attribute, *generalHarbourInformation/weatherResource* attribute as well as other complex attributes whose internal details are not shown in this figure).

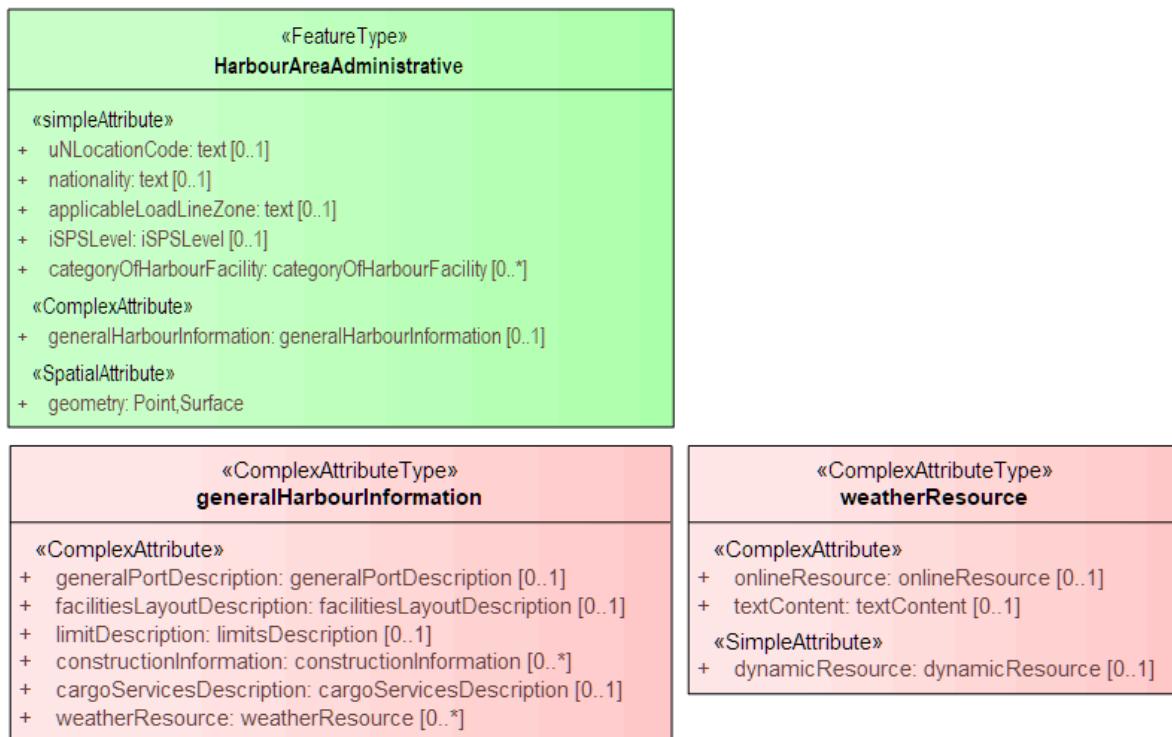


Figure 5-1 — Complex attribute

5.6 Units of measure

The following units of measure are used in Marine Harbour Infrastructure datasets;

- Orientation is given in decimal degrees
- Radio frequency is given in hertz
- Uncertainty is given in metres
- Distances are given in metres or nautical miles
- Depths are given in metres.

The feature catalogue specifies the unit of measure for each attribute for which a unit is needed.

6 Coordinate Reference Systems (CRS)

6.1 Introduction

An MHI dataset must define one geodetic CRS and one vertical CRS each for depths and elevations.

The location of an object in the S-100 standard is defined by means of coordinates which relate a feature to a position. 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 (φ) and longitude (λ) 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.

6.2 Horizontal Coordinate Reference System

The horizontal CRS must be EPSG 4326 (WGS84). The full reference to EPSG 4326 can be found at <https://epsg.org/home.html>.

Horizontal Coordinate Reference System:	EPSG 4326 (WGS84)
Projection:	None
Temporal reference system:	Gregorian calendar
Coordinate Reference System registry:	EPSG Geodetic Parameter Registry
Date type (according to ISO 19115-1):	002 — publication
Responsible party:	International Organisation of Oil and Gas Producers (IOGP)
URL:	https://epsg.org/home.html

6.3 Vertical CRS for Depths and Elevations

The vertical CRS must be in metres. Depths are represented by positive values, while negative values indicate intertidal (drying) soundings (for depths).

Depths and elevations may be referenced to different vertical datums. The vertical datum for each must be encoded in a meta-feature (**SoundingDatum** for depths and **VerticalDatum** for elevations). There should be only one vertical datum for all depths and only one for all elevations.

The vertical coordinate reference systems specified in **SoundingDatum** and **VerticalDatum** must be chosen so that the vertical axis directions are downward-positive for the CRS in **SoundingDatum** and upward-positive for the CRS in **VerticalDatum**.

6.4 Projections

MHI datasets are un-projected.

6.5 Temporal reference system

Time is measured by reference to Calendar dates and Clock time in accordance with [ISO 19108:2002, Clause 5.4.4, Temporal Schema](#).

6.6 Marine Harbour Infrastructure data and scale

MHI data must be compiled in the best applicable scale.

MHI datasets may be scale-dependent in that features may be compiled at a scale determined by data producer depending on the intended use of the dataset and spatial primitives may depend on the compilation scale. For example, detailed port features may be encoded as points in small-scale datasets but as polygons (surfaces) in large scale datasets.

The primary intended use of S-131 being for port information, most MHI datasets are expected to be large-scale datasets.

S-100 allows the association of multiple spatial attributes to a single feature instance. In principle, each of these spatial attributes can be qualified by maximum and minimum scales.

For example, it is possible, within one dataset, to have a single instance of a feature that has more than one area geometry. Each of these geometries has different scale max/min attributes. Moreover, due

to cluttering in smaller scales, the scale minimum attribute may be used to turn off portrayal of some features at smaller scales.

7 Datasets

7.1 Introduction

A dataset is a grouping of features, attributes, geometry and metadata which comprises a specific coverage.

7.2 Dataset rules

In order to facilitate the efficient processing of MHI data the geographic coverage of a given *maximumDisplayScale* may be split into multiple datasets.

The discovery metadata of a dataset must list all the **DataCoverage** features contained within that dataset and their assigned scale attributions.

7.3 Data coverages

Datasets and data coverage meta-features must conform to the following requirements:

- 1) All geographic features in a dataset must be covered by a **DataCoverage** meta feature.
- 2) An update dataset must not change the limit of a **DataCoverage** feature for the base dataset. Where the limit of a **DataCoverage** feature for a base dataset is to be changed, this must be done by issuing a new edition of the dataset.
- 3) All base datasets (new dataset, new edition and re-issue) must contain at least one **DataCoverage** feature.
- 4) The data boundary of the base dataset is defined by the extent of the **DataCoverage** features and must be contained within the bounding box. (It is not a requirement that the entire extent of the dataset bounding box be covered by **DataCoverage** feature(s).)
- 5) The **DataCoverage** features within a dataset must not overlap, however **DataCoverage** features from different datasets may overlap if they have differing maximum display scales.
- 6) Datasets may overlap, however there must be no overlapping **DataCoverage** features of the same *maximumDisplayScale*, 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.
- 7) When a dataset has multiple **DataCoverage** features, then the *minimumDisplayScale* must be the same for all **DataCoverage** features within the dataset. The **maximumDisplayScale** for multiple **DataCoverage** features within a dataset may be different.
- 8) When a dataset has multiple **DataCoverage** features then the *maximumDisplayScale* of the dataset must be equal to the largest *maximumDisplayScale* of the **DataCoverage** features.

NOTE: The *maximumDisplayScale* is considered to be the equivalent of the compilation scale of the data.

7.4 Data extent

Datasets must not cross the 180° meridian of longitude; this includes both the **DataCoverage** features and the bounding box for the dataset.

7.5 Types of datasets

[Table 7-1](#) lists the types of MHI datasets which may be produced and contained within an exchange set:

Table 7-1 — MHI dataset types

Dataset	Explanations
New dataset (base dataset)	Data for an area different (in coverage and/or extent) to existing datasets.
New Edition of a dataset	A re-issue plus new information which has not been previously distributed by Updates. Each New Edition of a dataset must have the same name as the dataset that it replaces and should have the same spatial extents. The edition number in the dataset discovery metadata must increment up by one from the previous edition.
Update dataset	A delta change of the latest edition of a dataset. If there is more than one update dataset, the subsequent update will be a delta of the base dataset + earlier update datasets.
Re-issue	Includes all the updates applied to the original dataset up to the date of the reissue. A Re-issue is intended to avoid unnecessary loading of the Base cell and all applicable updates individually for new users of the dataset, and therefore does not contain any new information additional to that previously distributed by updates. A reissue dataset can be issued at any time.
Cancellation	Cancels a dataset and any related update datasets. The dataset is cancelled and is deleted from the system. Datasets are cancelled using the file-less cancellation method described in S-100 17-4.4.1. Fileless cancellation may be achieved by using a dataset metadata entry with the filename and original digital signature specifying the resource to be cancelled and with all other mandatory metadata fields also set to the same values as the original, with the exception of the issueDate, which must be set to the issue date of the fileless cancellation itself. Since S-131 uses file-less cancellation, there is no cancellation data file. Cancellation is only by means of discovery metadata.

7.6 Content of update datasets

Update datasets can only contain replacements, deletions, and additions of whole feature instances or information instances.

7.7 Display scale range

A scale range of a dataset is used to indicate a range of scales between which a producer considers the data is intended for use. The smallest scale is defined by the **minimum display scale** and the largest scale by the **maximum display scale**. These scales must be set at one of the scales specified elsewhere in this product specification.

When the system's viewing scale is smaller than the value indicated by **minimum display scale**, features within the **Data Coverage** feature are not displayed, except where the System Database does not contain a dataset covering the area at a smaller scale, in which case the dataset will be displayed at all smaller scales. When the viewing scale is larger than the value indicated by **maximum display scale**, an overscale indication must be shown.

7.8 Data overlap

S-131 datasets must not overlap other S-131 datasets of the same scale range.

7.9 Geometry

7.9.1 S-131 geometry

Marine Harbour Infrastructure (MHI) features are encoded as vector entities which conform to S-100 geometry configuration level 3a (S-100 clause 7-4.3).

Level 3a is described by the following constraints:

- Each curve must reference a start and end point (they may be the same).
- Curves must not self intersect. See S-100 Figure 7-5.
- 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 (that is at one point) as shown in S-100 Figure 7-6.
- The outer boundary of a surface must be in a clockwise direction (surface to the right of the curve) and the curve orientation positive. The inner boundary of a surface must be in a counter-clockwise direction (surface to the right of the curve) and the curve orientation negative. See S-100 Figure 7-7.

S-131 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 segment contains the geographic coordinates as control points and defines an interpolation method between them. Coordinate density can have a significant impact on file size and system performance. A rule of thumb is to limit the coordinate density to 0.3 mm at maximum permitted display scale.
- For a scale-less product, the producer should keep in mind the expected scale range for typical use and the density of coordinates needed to suit the needs of the product.

The following exception applies to :-:

- The use of coordinates is restricted to two dimensions (*DirectPosition* is restricted to two coordinates).

7.9.2 Masking

In certain circumstances, the symbolisation of a curve may need to be suppressed. This is done using the *maskReference* XML tag described in S-100 10b-10.1.7.

7.9.3 Coordinate encoding in spatial primitives

Geometry may be encoded either inline or by reference to a spatial primitives located elsewhere in the dataset that encodes the actual coordinate values. The GML conventions for references and axis order must be followed.

The CRS shall be identified using the URI convention for SRS specified by OGC, which is <http://www.opengis.net/def/crs/EPSG/0/4326> (S-100 10b-11.7). The axis order is latitude/longitude.

7.10 Dataset size

MHI datasets must not exceed 20 MiB.

Update datasets must not exceed 500 KiB.

8 Data Quality

8.1 Introduction to Data Quality

Data quality allows users and user systems to assess fitness for use of the provided data. Data quality measures and the associated evaluation are reported as metadata of a data product. This metadata improves interoperability with other data products and provides scope for usage by user groups that the

data product was not originally intended for. The secondary users can make assessments of the data product usefulness in their application based on the reported data quality measures.

For S-131 the following data quality elements have been included:

- Conformance to this Product Specification;
- Intended purpose of the data product;
- Completeness of the data product in terms of coverage;
- Logical consistency;
- Positional uncertainty and accuracy;
- Thematic accuracy;
- Temporal quality;
- Aggregation measures;
- Validation checks or conformance checks including:
 - General tests for dataset integrity; and
 - Specific tests for compliance against the S-131 data model.

8.1.1 Data quality reports

For this edition of S-131, data quality reports are optional, because S-100 Edition 5.2.0 does not specify a report format or a location for data quality reports in exchange sets. If a data quality report is provided it must be separate from the exchange set (specifically, data quality reports are not treated as support files and are not included in the SUPPORT_FILES folder). The format of a data quality report is left to the producer or evaluator. The method of provision of data quality reports is also left to the producer or evaluator.

8.2 Completeness

The presence and absence of features is described by the data quality elements Completeness (including commission and omission). Completeness should only be used on the feature type level, describing whether the features in the universe of discourse are found in the data set or not.

8.2.1 Commission

Commission is applicable for S-131.

S-131 products must be tested with commission checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. It is allowable to publish the data with a quality statement which indicates non-conformance.

In terms of commission, S-131 products must at least populate `numberOfExcessItems` that indicates the number of items that should not have been present in the dataset, and `numberOfDuplicateFeatureInstances` that indicates the total number of exact duplications of feature instances within the data.

8.2.2 Omission

Omission is applicable for S-131.

S-131 products must be tested with omission checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

In terms of omission, S-131 products must at least populate `numberOfMissingItems` that indicates the total number of missing items.

8.3 Logical consistency

8.3.1 Conceptual consistency

Conceptual Consistency is applicable for S-131 and follows the guidelines from S-100 Part 1.

S-131 products must be tested with conceptual consistency checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

In terms of conceptual consistency, S-131 products shall at least populate `numberOfNonCompliantItems` that is a count of all items in the dataset that are noncompliant to the rules of the Conceptual Schema.

As a Product Specification with geometric surfaces, S-131 shall also at least populate `numberOfInvalidSurfaceOverlaps` that indicates the total number of erroneous overlaps within the data.

8.3.2 Domain consistency

Domain consistency is applicable for S-131 and follows the guidelines from S-100 Part 5.

S-131 products must be tested with domain consistency checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

In terms of domain consistency, S-131 products must at least populate `numberOfNonconformantItems` that is a count of all items in the dataset that are not in conformance with their value domain.

8.3.3 Format Consistency

Format Consistency is applicable for S-131 and follows the guidelines from S-100 Part 10b.

S-131 products must be tested with format consistency checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

In terms of Format Consistency, S-131 products must at least populate `physicalStructureConflictsNumber` that is a count of all items in the dataset that are stored in conflict with the physical structure of the dataset.

8.3.4 Topological consistency

Topological consistency is applicable for S-131 and follows the guidelines from S-100 Part 7.

S-131 products must be tested with topological consistency checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

As a Product Specification with curves and geometric surfaces, S-131 products must at least populate:

- `rateOfFaultyPointCurveConnections` that indicates the number of faulty link-node connections in relation to the number of supposed link-node connections;
- `numberOfMissingConnectionsUndershoots` that is a count of items in the dataset within the parameter tolerance that are mismatched due to undershoots;
- `numberOfMissingConnectionsOvershoots` that is a count of items in the dataset within the parameter tolerance that are mismatched due to overshoots;
- `numberOfInvalidSlivers` that is a count of all items in the dataset that are invalid sliver surfaces;
- `numberOfInvalidSelfIntersects` that is a count of all items in the dataset that illegally intersect with themselves; and
- `numberOfInvalidSelfOverlap` that indicates all items in the dataset that illegally self-overlap.

8.4 Positional uncertainty and accuracy

8.4.1 Absolute or external accuracy

8.4.1.1 Vertical position accuracy

Vertical Position Accuracy is not applicable for S-1XX which is a Product Specification without objects that have a vertical coordinative value associated.

8.4.1.2 Horizontal position accuracy

Horizontal position accuracy is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with horizontal position accuracy checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

In terms of horizontal position accuracy, S-131 products must at least populate circularError95 that indicates the radius describing a circle in which the true point location lies with the probability of 95%.

Recommendations on thresholds for Positional Accuracy / Absolute or External Accuracy are as follows:

Maximum RMSE (horizontal) = E / 10000

Maximum RMSE (vertical) = Vint / 6

Where:

E = Denominator of intended scale of mapping

Vint = Normal contour line interval

8.4.2 Relative or internal accuracy

Relative or internal accuracy is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with relative or internal accuracy checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. It is allowable to publish the data with a quality statement which indicates non-conformance.

In terms of relative or internal accuracy, S-131 products must populate one or both of relativeVerticalError that indicates an evaluation of the random errors of one relief feature to another in the same data set or on the same map/chart; and/or relativeHorizontalError that indicates an evaluation of the random errors in the horizontal position of one feature to another in the same data set or on the same map/chart.

8.4.3 Gridded data positional accuracy

Gridded data positional accuracy is not applicable for S-131 which is a Product Specification without objects that have a gridded coordinative value associated.

8.5 Thematic accuracy

8.5.1 Thematic classification correctness

Thematic classification correctness is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with thematic classification correctness checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

In terms of thematic classification correctness, S-131 products must at least populate miscalculationRate that indicates the number of incorrectly classified features in relation to the number of features that are supposed to be there.

8.5.2 Non-quantitative attribute accuracy

Non-quantitative attribute accuracy is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with non-quantitative attribute accuracy checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

The accuracy of non-quantitative attributes can be correct or incorrect. S-131 products shall at least populate numberOfIncorrectAttributeValues that is a count of all attribute values where the value is incorrect.

8.5.3 Quantitative attribute accuracy

Quantitative attribute accuracy is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with quantitative attribute accuracy checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. Data should only be published if it passes the test.

The accuracy of quantitative attributes can be measured in terms of uncertainty intervals. S-131 products shall at least populate attributeValueUncertainty3Sigma that indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%.

8.6 Temporal quality

8.6.1 Temporal consistency

Temporal consistency is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with temporal consistency checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in <X>. It is allowable to publish the data with a quality statement which indicates non-conformance.

8.6.2 Temporal validity

Temporal validity is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with temporal validity checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. It is allowable to publish the data with a quality statement which indicates non-conformance.

In terms of temporal validity, S-131 products must at least populate numberOfNonConformantItems that is a count of all items in the dataset that are not in conformance with their value domain.

8.6.3 Temporal accuracy

Temporal accuracy is applicable for S-131 and follows the guidelines from S-100 Part 4c.

S-131 products must be tested with temporal accuracy checks prior to release by the Data Producer. The Data Producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are listed in S-158:131. It is allowable to publish the data with a quality statement which indicates non-conformance.

In terms of temporal accuracy, S-131 products shall at least populate attributeValueUncertainty3Sigma that indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%.

8.7 Aggregation

Aggregation is applicable for S-131. The aggregated data quality result provides a result if the dataset has passed conformance to the Product Specification. A data set may be deemed to be of an acceptable aggregate quality even though one or more individual data quality results fails acceptance.

The quality of an S-131 dataset may be represented by one aggregated data quality results (ADQR). The ADQR combines quality results from data quality evaluations based on different data quality elements including Commission, Omission, Conceptual Consistency, Format Consistency, Topological Consistency, Horizontal Position Accuracy and Thematic Classification Correctness.

The aggregate data quality is determined by the formula:

$$\text{ADQR} = v_1 * v_2 * v_3 * \dots * v_n$$

Where n is the number of data quality measurement frames.

Where:

1 = Commission;

2 = Omission;

3 = Conceptual Consistency;

4 = Format Consistency;

5 = Topological Consistency;

6 = Horizontal Position Accuracy; and

7 = Thematic Classification Correctness.

Each data quality result involved in the computation is given a Boolean value of one (1) if it passed and zero (0) if it failed. If ADQR=1, then the overall data set quality is deemed to be fully conformant, hence pass. If ADQR=0, then it is deemed non-conformant, hence fail.

8.8 Quality measure elements

The data quality measures recommended in S-97 (Part C) and their applicability in S-131 are indicated in [Table 8-1](#) below. NA indicates the measure is not applicable. This table reproduces the first 4 columns of the data quality checklist recommended elements and replaces the final column with descriptions of the scope of the element in the context of S-131 datasets.

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Table 8-1 — Quality measure elements

No.	Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-131
1	Completeness / Commission	Excess data present in a dataset, as described by the scope.	numberOfExcessItems / This data quality measure indicates the number of items in the dataset, that should not have been present in the dataset.	dataset/ dataset series	All features and info types
2	Completeness / Commission	Excess data present in a dataset, as described by the scope.	numberOfDuplicateFeatureInstances / This data quality measure indicates the total number of exact duplications of feature instances within the data.	dataset/ dataset series	All features and info types
3	Completeness / Omission	Data absent from the dataset, as described by the scope.	numberOfMissingItems / This data quality measure is an indicator that shows that a specific item is missing in the data.	dataset/ dataset series/spatial object type	All features and info types
4	Logical Consistency / Conceptual Consistency	Adherence to the rules of a conceptual schema.	numberOfNonCompliantItems / This data quality measure is a count of all items in the dataset that are noncompliant to the rules of the Conceptual Schema.	spatial object / spatial object type	All features and info types
5	Logical Consistency / Conceptual Consistency	Adherence to the rules of a conceptual schema.	numberOfInvalidSurfaceOverlaps / This data quality measure is a count of the total number of erroneous overlaps within the data. Which surfaces may overlap and which must not is application dependent. Not all overlapping surfaces are necessarily erroneous.	spatial object / spatial object type	Features with surface geometry; spatial objects of type surface
6	Logical Consistency / Domain Consistency	Adherence of the values to the value domains.	numberOfNonconformantItems / This data quality measure is a count of all items in the dataset that are not in conformance with their value domain.	spatial object / spatial object type	All features and info types
7	Logical Consistency / Format Consistency	Degree to which data is stored in accordance with the physical structure of the data set, as described by the scope	physicalStructureConflictsNumber / This data quality measure is a count of all items in the dataset that are stored in conflict with the physical structure of the dataset.	dataset/ dataset series	All features and info types
8	Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological	rateOfFaultyPointCurveConnections / This data quality measure indicates the number of faulty link-node connections in relation to the number of supposed link-node connections. This data quality	spatial object /	Features with curve geometry;

No.	Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-131
		characteristics of the dataset, as described by the scope.	measure gives the erroneous point-curve connections in relation to the total number of point-curve connections.	spatial object type	spatial objects of curve types
9	Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfMissingConnectionsUndershoots / This data quality measure is a count of items in the dataset within the parameter tolerance that are mismatched due to undershoots.	spatial object / spatial object type	Features with curve geometry; spatial objects of curve types
10	Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfMissingConnectionsOvershoots / This data quality measure is a count of items in the dataset within the parameter tolerance that are mismatched due to overshoots.	spatial object / spatial object type	Features with curve geometry; spatial objects of curve types
11	Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfInvalidSlivers / This data quality measure is a count of all items in the dataset that are invalid sliver surfaces. A sliver is an unintended area that occurs when adjacent surfaces are not digitized properly. The borders of the adjacent surfaces may unintentionally gap or overlap to cause a topological error.	dataset / dataset series	Features with surface geometry; spatial objects of type surface
12	Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfInvalidSelfIntersects / This data quality measure is a count of all items in the dataset that illegally intersect with themselves.	spatial object / spatial object type	Features with surface geometry; spatial objects of type surface or curve
13	Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfInvalidSelfOverlap / This data quality measure is a count of all items in the dataset that illegally self-overlap.	spatial object / spatial object type	Features with surface geometry; spatial objects of type surface or curve

No.	Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-131
14	Positional Accuracy / Vertical Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	linearMapAccuracy3Sigma / Half length of the interval defined by an upper and lower limit in which the true value lies with probability 95%.	spatial object / spatial object type	N/A S-131 does not use 3-D coordinates.
15	Positional Accuracy / Horizontal Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	circularError95/Radius describing a circle in which the true point location lies with the probability of 95%.	spatial object / spatial object type	objects that have a horizontal coordinate values associated.
16	Positional Accuracy / Relative or Internal Accuracy	Closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true.	relativeVerticalError / An evaluation of the random errors of one relief feature to another in the same data set or on the same map / chart. It is a function of the random errors in the two elevations with respect to a common vertical datum. [Adapted from ISO 19157]	spatial object / spatial object type	PS with objects that have a coordinative value associated.
17	Positional Accuracy / Relative or Internal Accuracy	Closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true.	relativeHorizontalError / An evaluation of the random errors in the horizontal position of one feature to another in the same data set or on the same map/chart. [Adapted from ISO 19157]	spatial object / spatial object type	PS with objects that have a coordinative value associated.
18	Positional Accuracy / Gridded Data Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	RMSerrorPlanimetry / Radius of a circle around the given point, in which the true value lies with probability P.	spatial object / spatial object type	NA. S-131 does not have features with gridded geometry
19	Temporal Quality / Temporal Consistency	Correctness of ordered events or sequences, if reported.	chronologicalOrder / This data quality measure that indicate that an event is incorrectly ordered against the other events. [Adapted from ISO 19157]	dataset/ dataset series/spatial object type	Features with time intervals, fixed/periodic date ranges, schedules.
20	Temporal Quality / Temporal Validity	Validity of data with respect to time	numberOfNonConformantItems / This data quality measure is a count of all items in the dataset that are not in conformance with their value domain. [Adapted from ISO 19157]	dataset/ dataset	Features with time intervals, fixed/periodic

No.	Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-131
				series/spatial object type	date ranges, schedules.
21	Temporal Quality / DQ_AccuracyOfATimeMeasurement	Correctness of the temporal references of an item (reporting of error in time measurement)	attributeValueUncertainty3Sigma / This data quality measure indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%. [Adapted from ISO 19157]	dataset/ dataset series/spatial object type	Features with time intervals, fixed/periodic date ranges, schedules.
22	Thematic Accuracy / ThematicClassificationCorrectness	Comparison of the classes assigned to features or their attributes to a universe of discourse.	miscalculationRate / This data quality measure indicates the number of incorrectly classified features in relation to the number of features that are supposed to be there. [Adapted from ISO 19157:2013] This is a RATE which is a ratio, and is expressed as a REAL number representing the rational fraction corresponding to the numerator and denominator of the ratio. For example, if there are 1 items that are classified incorrectly and there are 100 of the items in the dataset then the ratio is 1/100 and the reported rate = 0.01.	dataset/ dataset series/spatial object type	All features and info types
23	Thematic Accuracy / Non-Quantitative Attribute Accuracy	Correctness of non-quantitative attribute.	numberOfIncorrectAttributeValues / This data quality measure is count of the total number of erroneous attribute values within the relevant part of the dataset. It is a count of all attribute values where the value is incorrect. [Adapted from ISO 19157]	dataset/ dataset series/spatial object type	Features and info types with non-quantitative attribute value.
24	Thematic Accuracy / Quantitative Attribute Accuracy	Accuracy of a quantitative attribute.	attributeValueUncertainty3Sigma / This data quality measure indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%. [Adapted from ISO 19157]	dataset/ dataset series/spatial object type	Features and info types with quantitative attribute value.
25	Aggregation Measures / AggregationMeasures	In a data product specification, several requirements are set up for a product to conform to the specification.	DataProductSpecificationPassed / This data quality measure is a boolean indicating that all requirements in the referred data product specification are fulfilled.	dataset/ dataset series/spatial object type	Dataset as a whole
26	Aggregation Measures / AggregationMeasures	In a data product specification, several	DataProductSpecificationFailRate / This data quality measure is a number indicating the number of data product specification	dataset/ dataset	Dataset as a whole

No.	Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-131
		requirements are set up for a product to conform to the specification.	requirements that are not fulfilled by the current product/dataset in relation to the total number of data product specification requirements.	series/spatial object type	

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8.9 Test methods for data compliance and usability

Test methods for evaluating data compliance consist of executing the relevant tests from the Validation Checks (S-158:131) for each quality element in [Table 8-1](#) and counting the number of instances in the dataset which fail the checks for that quality element.

Note that in some cases “executing the relevant test” may involve comparing the encoded S-131 dataset to the source material by visual means. For tests requiring visual comparison of encoded data to source material, sampling methods may be used if the volume of data precludes checking all the relevant data objects.

Accuracy computations for Positional Accuracy / Absolute or External Accuracy should use the following recommendations:

Maximum RMSE (horizontal) = $E / 10000$

Where:

E = Denominator of intended scale of mapping

In addition to the above, dataset usability must be assessed against:

- Intended user requirements in regard to coverage, scale and specific content requirements as defined by the Producing Agency and key stakeholders;
- Conformance to established maintenance processes; and
- Overall compliance with the S-131 Product Specification, including context-specific evaluation of individual encoding instances for requirement of conformance to checks classified as “Error” and “Warning” in S-158:100 (generic S-100 validation checks) and S-158:131 (product-specific validation checks).

For dataset integrity requirements, see clause [13.8](#).

9 Data Capture and Classification

The S-131 MHI Data Classification and Encoding Guide (DCEG) describes how data describing the real world should be captured using the types defined in the S-131 Feature Catalogue. This Guide is provided as Annex A.

10 Maintenance

10.1 Introduction

This clause describes the requirement to adequately maintain datasets; use of newly acquired source data; maintenance requirements within the overall production process; and how Feature and Portrayal Catalogues are to be managed within an S-100 based marine navigation system.

10.2 Maintenance and update frequency

Datasets must be maintained as needed; and the overall production process must include mechanisms for updating designed to meet the needs of the mariner regarding safety of navigation.

10.3 Data Source

Data Producers must use all available and applicable sources, as evaluated against a robust data assessment process, to maintain and update datasets as required.

10.4 Production Process

Data Producers should follow their established production processes for maintaining and updating datasets. Data must be maintained against S-131 Annex A—*Data Classification and Encoding Guide*, checked against validation checks in S-158:100 and S-158:131 (generic and product-specific validation checks respectively), and encapsulated in GML conforming to the S-131 GML schema.

10.5 Dataset updates and cancellation

The purpose of issue of the dataset is indicated in the “purpose” field of the dataset discovery metadata. Cancellation used the file-less cancellation method described in S-100 Part 17.

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 along with all related update datasets and support files.

An exchange set may contain base dataset files and update dataset files for the same datasets. Under these circumstances the update dataset files must follow in the correct sequential order from the last update applied to the base dataset file.

10.6 Support file updates

The purpose of issue is indicated in the “purpose” field of the support file discovery metadata. Support files carrying the “deletion” flag in metadata must be removed from the system. When a feature or information type 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 or information type references the same file before that file is deleted.

Updates or deletions of a support file may require concurrent updates to feature or information type instance attributes that depend on the file, e.g., pictorialRepresentation, fileReference, and fileLocator attributes.

10.7 Feature and Portrayal Catalogue management

For each new version of the S-131 Product Specification a new Feature and Portrayal Catalogue will be released. The end user system must be able to manage datasets and their corresponding Catalogues that are created using different versions of the S-131 Product Specification.

10.8 Feature history, versions, and change tracking

If applications or production systems require versioning of individual instances of feature or information types, maintenance of histories, or change tracking, the methods for versioning, history management, and change tracking and display are left to the application or production system.

10.9 Dataset encryption

Encryption of datasets is at producer discretion. S-100 Part 15 and IHO publication S-63 describe the IHO scheme for data protections.

11 Portrayal

11.1 Introduction

S-131 portrayal is intended to provide a way to visualize the contents of S-131 information either in isolation or in combination with an S-101 ENC.

S-131 portrayal is covered by the portrayal model as defined in S-100. The Portrayal Catalogue defines symbology and the portrayal rules for each feature/attribute combination contained in the Feature Catalogue.

S-131 uses the portrayal process defined in S-100 Part 9.

11.2 Portrayal Catalogue

Citation information for the Portrayal Catalogue is provided in [Table 11-1](#) below.

Table 11-1 — S-131 Portrayal Catalogue

No.	ISO class or attribute	Type	Value
—	CI_Citation	Class	—
1	title	CharacterString	S-131 Portrayal Catalogue
2	date	CI_Date (class)	—
2.1	date	DateTime	2025-12-31 (or later—see note)
2.2	dateType	CI_DateTypeCode (ISO codelist)	publication
3	edition	CharacterString	2.0.0
4	editionDate	DateTime	2025-12-31 (or later—see note)
5	citedResponsibleParty	CI_Responsibility (class)	—
5.1	role	CI_RoleCode (ISO codelist)	publisher
5.2	party	CI_Organisation (class)	—
5.2.1	name	CharacterString	International Hydrographic Organization
6	otherCitationDetails	CharacterString	(reserved)
7	onlineResource	CI_OnlineResource (class)	—
7.1	linkage	CharacterString (URL)	https://registry.iho.int/
7.2	name	CharacterString	S-131 Portrayal Catalogue
7.3	description	CharacterString	XML Portrayal Catalogue accompanied by related files for symbols, colour profiles, rules, etc

NOTE: As of the preparation of this document, development tools and viewers for S-100 GML datasets using S-100-conformant portrayal catalogues are not available. The portrayal catalogue may therefore need to be updated and later builds with later dates may become available as development tools and viewers are updated.

11.3 General rules and guidelines

11.3.1 The attribute *language*

The attribute *language* is intended to allow the portrayal implementation to select instances of information types or complex attributes according to the user's preferred language. Implementers should use *language* values to structure the display according to the language settings, for example to display feature names (from the *featureName* complex attribute) in the preferred language or link to support files in the preferred language (as indicated by the *language* attribute of complex attribute *information*).

If there is no preferred language set by the display or there is no instance in the preferred language, the default instance (designated by the absence of a *language* attribute or with *language* attribute indicating English) should be displayed.

The specification of the *language* attribute in the IHO GI registry states "The language is encoded by a 3 character code following ISO 639-2/T." These codes and the corresponding language names for display purposes may be obtained from the codelist *S100_MD_LanguageCode* in the S-100 codelists file, which is part of the S-100 schemas distribution¹.

11.3.2 Structured text in displays

Sailing directions may provide information in structured form (tables, bulleted or numbered lists, etc.), which may be taken as guidance for online display of the S-131 equivalents, since mariners may be familiar with the structure of similar information in printed or digital publications.

11.4 Schedules

Schedule information is encoded in the **ServiceHours** and **NonStandardWorkingDay** information types. Schedules should be displayed as tabulations according to the day of the week. A template for the tabulation is shown in [Table 11-2](#). The objects and attributes from which the displayed information is derived are shown in italics. Implementers may deviate from the layout shown provided the resulting display shows at least the information specified in the table (for example, exceptions from **NonStandardWorkingDay** may be placed in an additional column instead of a separate row, or merged into the *Notes* column).

Table 11-2 — General layout of schedules display

Operations	Days	Times	Notes
(Table sub-header, from <i>featureName</i> if present — omit this row if <i>featureName</i> is not present)Links to other unusual attributes like source and graphic can be included here.			
Normal, Closed, Unmanned OR other: abcde Attribute <i>categoryOfSchedule</i> From <i>ServiceHours</i> Date ranges <i>fixedDataRange</i> , <i>periodicDateRange</i>	(Day(s) of week) DoW (single day) OR DoW—DoW (if <i>dayOfWeekIsRange = true</i>) OR DoW, DoW (if <i>dayOfWeekIsRange = false</i>)	(Times of day) hh:mm–hh:mm hh:mm–hh:mm ... <i>timeOfDayStart</i> , <i>timeOfDayEnd</i>	(Additional information) <i>complex attribute information</i>
(repeat according to multiplicity of <i>scheduleByDayOfWeek</i>)			
Exceptions	(fixed and variable date(s) from <i>dateFixed</i> or <i>dateVariable</i>)		(Additional information) <i>complex attribute information</i>

¹ Available from <https://schemas.s100dev.net>. The XML and human-readable versions of the codelists file for S-100 Edition 5.2.0 are located at <https://schemas.s100dev.net/schemas/S100/5.2.0/resources/Codelists/cat/codelists.xml> and <https://schemas.s100dev.net/schemas/S100/5.2.0/resources/Codelists/cat/codelists.html> respectively.

Operations	Days	Times	Notes
<i>NonStandardWorkingDay</i> associated to the above <i>ServiceHours</i>			
<i>(repeat both rows above, according to multiplicity of ServiceHours associated to the feature or information type)</i>			
NOTE			
1) The "Normal, Closed, ..." row represents information from ServiceHours , the "Exceptions" row from NonStandardWorkingDay associated to that ServiceHours .			
2) If there is more than one ServiceHours instance associated to the same feature or information type, the rows are repeated. This might be the case if there are different schedules for different types of operations (normal, unmanned, etc.).			
3) DoW represents <i>scheduleByDayOfWeek.timeIntervalsByDayOfWeek.dayOfWeek</i> .			
4) Times must be ordered according to the sequence of <i>timeOfDayStart</i> and <i>timeOfDayEnd</i> attributes in the dataset (this allows for encoding multiple periods in the day if needed, for example 08:00—12:00 and 13:00—17:00).			
5) The "Notes" column contains the content of the information attribute of ServiceHours or NonStandardWorkingDay (either the content of the text sub-attribute or a link to the text, as appropriate).			
6) Inclusion of the header row(s) is left to implementer discretion.			
7) Other attributes (for example, <i>graphic</i>) are not expected to be used for encoding schedule information, but if populated should be accessible via the "Notes" column or in header or trailer rows.			

Since S-100 Edition 5.2.0 portrayal does not provide for specifying templates for text formatting, the implementation of tabular forms must be left to implementers for this edition. As a provisional alternative, information may be displayed in text form, with rows of [Table 11-2](#) converted to phrases:

Normal operation: (date range) DoW-DoW, hh:mm-hh:mm, (additional information/link)

Exceptions: (fixed/variable dates), (additional information/link)

11.5 Limitations based on vessel dimensions and other characteristics

The information type **Applicability** may be displayed in either text or tabular form. Of the attributes of **Applicability**, all but *logicalConnectives* express a conditional phrase, while *logicalConnectives* encodes how the separate conditional phrases are linked.

Multiple values of attributes which allow more than one value (*categoryOfCargo* and *categoryOfDangerousOrHazardousCargo*) should be treated as "inclusive OR" (i.e., if *categoryOfCargo*=1 and 2, then it means vessels with either bulk or container cargo, or both).

Text form means natural language phrases generated from the attributes and their values. The suggested method is to generate a text phrase from each attribute (except *logicalConnectives*) and its value, and use *logicalConnectives* to add connectives. For example, a single **Applicability** object encoding all the three conditions in [Table 4-1](#) and *logicalConnectives*=AND can be converted as the condition:

"length overall greater than 50 metres AND less than 90 metres, AND breadth greater than 20 metres"

or into a bulleted list:

- length overall greater than 50 metres, and
- length overall less than 90 metres, and
- breadth greater than 20 metres.

The text so generated should be linked or otherwise related to the feature or information type to which it applies depending on the nature (and attributes, if any) of the association between **Applicability** and the feature or information type to which it is associated. For example, the text generated might be preceded by the text of the linked **Regulation** (for **InclusionType** associations), or the text generated from **Applicability** appear in a hover box linked to a geographic feature (for **PermissionType** associations).

Tabular display or mixed tabular/text display of conditions is also allowable. The design of tabular forms is left to implementers in this edition since S-100 portrayal in Edition 5.2.0 does not provide for the specification of table templates.

12 Data Product format (encoding)

12.1 Format specification

The format for datasets must conform to the S-131 GML schema specified below. See S-100 Part 10b and the S-131 GML schema documentation for a complete description of the data records, fields and subfields defined in the encoding.

Table 12-1 — Format specification 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	S-100 profile of GML (S-100 Part 10b)
Language	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.language	English
Character set	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.characterSet > MD_CharacterSetCode	004 — utf8
Additional Information	DPS_DeliveryInformation.additionalInformation > DPS.AdditionalInformation.additionalInformation	GML schema for S-131 Edition 2.0.0 (https://schemas.s100dev.net)

12.1.1 Specification of schema location

It is strongly recommended that all MHI datasets include the XML Schema *schemaLocation* attribute on the root element giving the physical location of the S-131 GML schema XSD file. This file will be placed on the schema server <https://schemas.s100dev.net> after approval of S-131 edition 2.0.0.

The nominal URL of the GML schema is expected to be

https://schemas.s100dev.net/schemas/S128/2.0.0/<YYYYMMDD>/131_2.0.0.xsd
where <YYYYMMDD> represents the build date. The precise URL can be obtained via the schema server or GI Registry after publication of S-131 edition 2.0.0.

Implementations should provide for local redirections of the nominal location of the GML schema using an implementation capable of using OASIS XML catalogs or another means of resolving the schema server URL to reference a different physical file location.

Note that the physical location specified in *schemaLocation* provides “hints as to the physical location of schema documents” according to the XML Schema specification. The location(s) provided in *schemaLocation* may therefore be overridden by schema-aware validators or applications.

12.2 Encoding of latitude and longitude

Values of latitude and longitude must be accurate to 7 decimal places. Coordinates must be encoded as decimals in the format described below.

- 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).

12.3 Encoding of depths

Depths are encoded in the format and precision specified in the feature catalogue for the corresponding attribute. Positive values indicate distances below the applicable datum reference.

12.4 Numeric attribute encoding

Integer attribute values must not contain leading zeros.

Floating point attributes must not contain leading zeros. Values in the interval (-1, 1) may use a single zero before the decimal point.

Floating point attribute values must not contain non-significant trailing zeros exceeding the attribute's precision as specified in the feature catalogue.

12.5 Text attribute values

Character strings must be encoded using the character set defined in [ISO/IEC 10646](#), in Unicode Transformation Format-8 (UTF-8).

12.6 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 the Data Classification and Encoding Guide.

12.7 Unknown attribute values

When an attribute code is present but the attribute value is missing, it means that the producer wishes to indicate that this attribute value is unknown.

12.8 Object identifiers

Feature records must have a unique world-wide identifier. When an MRN naming scheme is finalised by IHO, the identifier must be derived from the MRN of the feature by a reversible 1/1 mapping (i.e., each identifier must map to a corresponding unique MRN and each MRN must map to a corresponding unique feature identifier).

MRN identifiers are not included in this version due to ongoing development of the IHO guidelines in the use of MRN for product specifications.

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.

12.9 Data quality meta-features

One or more `QualityOfNonBathymetricData` features must cover the dataset.

12.10 Sequence of objects

The following sequence of objects is recommended:

Spatial records for by-reference geometries

- Point
- Multi point
- Curve
- Composite Curve
- Surface

Information objects

Feature objects

- Meta features
- Cartographic Features
- Geo features

12.11 Data format for update datasets

The data format for update datasets is the same as that for base datasets (clause [12.1](#)).

12.11.1 Attributes

Instances of feature or information types in update datasets must contain all the attributes of the old instance, including any inline spatial attributes (i.e., inline geometry), except those attributes that are being removed.

12.11.2 Associations

An association to an instance of a feature or information type is treated as an attribute of the referring instance, and therefore adding or deleting an association means the original referring instance must be replaced with a new version. The instance at the other end of the association needs to be replaced if and only if it contains a reference to the first instance.

12.11.3 Spatial primitives

Spatial primitives that are not inline (that is, geometry that is encoded as an independent spatial object in the dataset) are treated like any other object, that is, it needs to be updated if and only if the primitive has changed (for example, a coordinate is updated).

Spatial primitives are also updated (for example, to update coordinates) as whole objects.

- For inline spatial primitives, this entails updating the entire feature instances.
- Non-inline spatial primitives are updated by encoding the replacement in its entirety in the update dataset. The replacement must have the same *gml:id* as the object it replaces.

12.11.4 Deletion

Feature and information type instances are deleted without replacement by setting the *fixedDateRange.dateEnd* attribute of the instance to the date of deletion, which will usually be the issue date of the update.

Spatial objects that are not inline can be deleted without replacement only by releasing a new edition of the dataset omitting the spatial object to be removed.

12.12 Datum coverage

All features in a dataset with depth or elevation attributes must be covered by **SoundingDatum** and **VerticalDatumOfData** meta-features respectively.

12.13 Attribute multiplicity

In general, if all the sub-attributes of a complex attribute are optional, at least one of them must be present and have a value that is not empty (or white space, for attributes of type “text” or types derived from “text”).

Similarly, if all the attributes of an information type are optional, at least one of them must be present and have a non-empty value.

Note that there is no such general rule for features, though the DCEG may require it for specific features.

13 Data Product Delivery

Data which conforms to this Product Specification must be delivered by means of an Exchange Set.

13.1 Exchange set components

S-131 uses the same exchange set components and metadata as S-100. [Figure 13-1](#) depicts the exchange set components (datasets and feature/portrayal catalogues) and exchange set metadata. This figure is derived from Figure 17-2 in S-100. Note also that the link between S100_Dataset and S100_CatalogueMetadata is implicit by means of the S-131 version to which the feature catalogue, portrayal catalogue, and dataset conform, which must have the same edition and revision components.

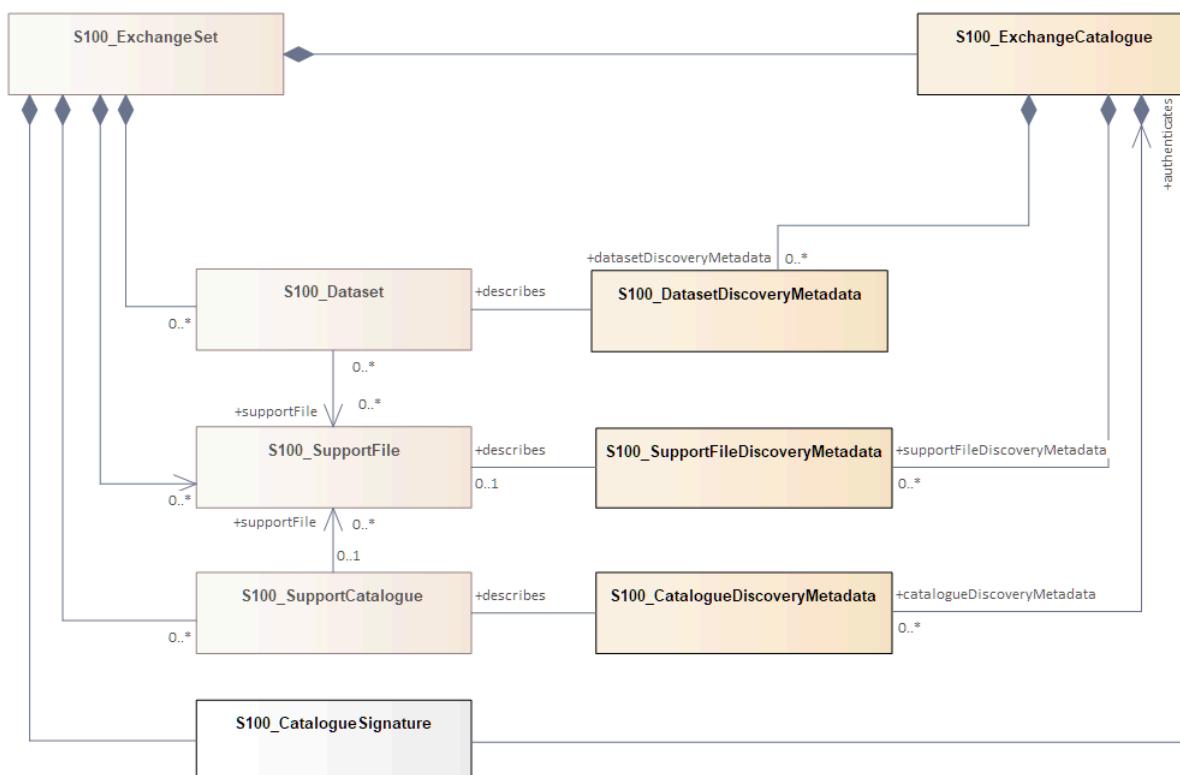


Figure 13-1 — Components and associated metadata for the S-131 exchange set (S-100 Figure 17-2)

The rules governing the presence and roles of the exchange set components depicted in [Figure 13-1](#) are given below.

- 1) Every exchange set must contain an Exchange Catalogue, represented by **S100_ExchangeCatalogue** in [Figure 13-1](#).
- 2) Dataset discovery metadata (**S100_DatasetDiscoveryMetadata**) must be provided in the exchange catalogue for each S-131 dataset in the exchange set.

- 3) Catalogue metadata (**S100_CatalogueDiscoveryMetadata**) must be provided in the exchange catalogue for any feature and portrayal catalogues included in the exchange set.
- 4) S-131 allows exchange sets to include the following types of support files:
 - a) Text and picture support files referenced by datasets (**S100_SupportFile**).
 - b) Language packs (**S100_SupportFile**).
- 5) Text and picture support files referenced in a dataset must be included in the exchange set.
- 6) The inclusion of language packs in exchange sets is optional.
- 7) Language packs are described in S-100 Part 18 and provide translations of feature catalogues.
- 8) A signature file for the exchange catalogue must also be included in the exchange set (**S100_CatalogueSignature**).

The tangible representations of the structure classes in [Figure 13-1](#) within actual exchange sets are the digital files or folders containing the exchange set, dataset(s), catalogue(s), and support files. The tangible representations of their roles as depicted in [Figure 13-1](#) are the inclusion of the respective components within the exchange set. Documentation tables for the structure classes are not provided since the exchange set structure is described in this clause.

The metadata classes in [Figure 13-1](#) are represented by XML files or XML blocks and are documented in clause [14.2](#).

Each Exchange Set consists of one or more MHI datasets and a single Exchange Catalogue XML file containing metadata. It may also include one or more support files (or no support files). The Exchange Set structure is the same as that described in S-100 Clause 17-4.2.

13.2 Encapsulation

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

An Exchange Set is encapsulated into a form suitable for transmission as packages (such as ZIP archives or files organised within a file system folder/directory structure), containing both the exchange catalogue and one or more data products (of possibly different S-100 types), with each product covering a specific geographic region and specific period of time.

The contents of an Exchange Set are :

- Mandatory elements
 - Exchange Catalogue—the XML encoded description of the content of the Exchange Set (discovery metadata).
- Optional elements
 - S-131 datasets—Since it is possible for an exchange set to contain only a feature or portrayal catalogue, or only a support file which is being updated or delivered as a new file, datasets are an optional component of S-131 exchange sets.
 - Supplementary files—These are contained within the Exchange Set as files. If the exchange set contains a dataset, the support files referenced in the dataset must be included.
 - S-131 Feature Catalogue—if it is necessary to deliver the latest Feature Catalogue to the end user it may be done using the S-131 Exchange Set mechanism.
 - S-131 Portrayal Catalogue—if it is necessary to deliver the latest Portrayal Catalogue to the end user it may be done using the S-131 Exchange Set mechanism.

13.2.1 Packaging of catalogues and language packs

Since feature and portrayal catalogues apply to all datasets for a single version of a Product Specification, a common practice is for the IHO Secretariat to create special exchange sets containing feature and portrayal catalogues (and no datasets). These special exchange sets are generally made available by the IHO Secretariat in the IHO Geospatial Information Registry. It is recommended that this practice be followed for Edition 2.0.0 too. It is therefore not necessary to include feature and portrayal catalogues in each exchange S-131 set.

Similar practice is recommended for language packs, allowing for the possibility that language packs may be developed and distributed by national hydrographic offices or equivalent agencies instead. Data

producers desirous of developing language packs should contact the NIPWG Chair and IHO Secretariat to discuss arrangements.

13.3 Dataset

13.3.1 Metadata for different types of datasets

[Table 13-1](#) describes the encoding format and required values of dataset discovery metadata for the types of datasets and exchange sets permitted by S-131. Detailed explanations of each type are provided in clause [7.5](#).

Table 13-1 — Types of datasets

Dataset Type	Encoding Format	Discovery metadata purpose field
New dataset	Clause 12	<i>newDataset</i>
Re-issue	As for new dataset	<i>reissue</i>
New Edition of a dataset	As for new dataset	<i>newEdition</i>
Update dataset	As for new dataset. See clause 12.11 .	<i>update</i>
Cancellation	Not applicable	<i>cancellation</i>

13.3.2 Dataset file naming

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 (clause [13.3.1](#)).

S-131 dataset files for new, reissue, new editions, and cancellation datasets are named according to the specifications given below:

131CCCCXXXXXXXXXX.GML

The main part forms an identifier where:

- The first three characters are always “131” and identify the dataset as an S-131 dataset.
- The next four characters identify the issuing agency by its four-character alphanumeric agency code in the IHO producer code register in the IHO GI Registry.

Suffixing zeros is a temporary expedient pending conversion of the IHO producer code registry to 4-character codes. When 4-character IHO producer codes are published, they must be used.

- The subsequent characters 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).
- The ninth and subsequent characters are optional (i.e., at least one character must be used after the producer code).
- The maximum length of the file name must be 64 characters including the extension and its preceding ‘.’ character. Note that since update datasets must follow the same rule, allowing for updates lowers this limit (e.g., allowing for 999 updates reduces the limit for base datasets by 4 characters).

13.3.3 Update dataset naming convention

All update dataset files will have an identical name to the base dataset, aside from the separator and update number sequence.

S-131 update dataset files are named according to the specifications given below:

131CCCCXXXXXXXXXX_XXX.GML

The main part forms an identifier where:

- The first character up to the final underscore characters are the same as the dataset being updated and therefore conform to the rules described in clause [13.3.2](#).

- The next character must be an underscore “_”.
- The next three characters must be numerical (0-9) characters to indicate the place of the update dataset in the update sequence.
- The maximum length of the name must be 64 characters including the extension and its preceding “.” character.

13.3.4 New Editions, re-issues, updates and cancellations

This section defines the sequencing of S-131 datasets for New Editions, updates and re-issues. In order to ensure that feature type updates are incorporated into an end user system in the correct sequence without any omission, a number of parameters encoded in the data are used in the following way:

Edition number	When a dataset is initially created (Base dataset), the Edition number 1 is assigned to it. The Edition number is increased by 1 at each New Edition.
Update number	Update number 0 is assigned to a new dataset and a New Edition. The first update dataset file associated with this new dataset must have update number 1. The update number must be increased by one for each subsequent update, until a New Edition is released. A re-issue of a dataset must have the update number of the last update applied to the dataset, and use the same Edition number.
Update comment	Comment for describing the change introduced by an update.
Issue date	Date up to which the Data Producer has incorporated all applicable changes. The issue date must be greater than the previous issue date of the dataset.

In order to cancel a dataset, a dataset discovery metadata record must be created in an exchange catalogue with *purpose = cancellation* and the filename and original digital signature specifying the dataset to be cancelled, and with all other mandatory metadata fields also set to the same values as the original base dataset, with the exception of the issueDate, which must be set to the issue date of the fileless cancellation itself (S-100 Edition 5.2.0 Part 17 clause 17-4.4.1). 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.

An Exchange Set may contain Base dataset files and update dataset files for the same datasets. Under these circumstances the update dataset files must follow on in the correct sequential order from the last update applied to the Base dataset file.

13.4 Exchange set structure

The structure of an S-131 exchange set must be according to the structure described below, which is based on S-100 Clause 17-4.2. The S-131 exchange set structure is depicted in [Figure 13-2](#).

- 1) All content must be placed inside a top root folder named S100_ROOT. This is the only top level root folder in an exchange set containing only S-100 products.
- 2) The S100_ROOT folder must contain a subfolder for S-131 which holds content specific to S-131.
- 3) An S-131 exchange set must contain an exchange set catalogue, CATALOG.XML, its digital signature CATALOG.SIGN and may contain any number of S-131 conformant dataset files and catalogue files.
- 4) The S-131 subfolder must contain subfolders for the component dataset files (DATASET_FILES), support files (SUPPORT_FILES), and catalogues (CATALOGUES) as required:
 - a) The DATASET_FILES subfolder is required if and only if the exchange set contains an S-131 dataset.
 - b) The CATALOGUES subfolder is required if and only if the exchange set contains a feature, interoperability, or portrayal catalogue.
 - c) The SUPPORT_FILES folder is required if and only if the exchange set contains at least one S-131 support file.
- 5) The DATASET_FILES folder must contain a subfolder named according to the producer code.

- 6) Individual data files must be placed under the producer subfolder, either directly in the producer folder, or within a lower-level subfolder hierarchy. Individual data files may be optionally placed in their own subfolders or grouped with other data files.
- 7) An exchange set may carry feature and portrayal catalogues in different versions, which should also be grouped together in the CATALOGUES folder.
- 8) If a portrayal catalogue is included in the exchange set, it may be packaged as either a ZIP archive containing all portrayal catalogue files, or a filesystem structure of folders and files. The structure of portrayal catalogues is described in S-100 Part 9 Clause 9-13.2.
- 9) Except for the signature of the exchange catalogue file (CATALOG.XML), which is in the CATALOG.SIGN file, all digital signatures are included within their corresponding resource metadata records in CATALOG.XML.
- 10) Dataset and catalogue file and/or folder names should be such as to avoid inadvertent overwriting of files.
- 11) Digital signatures for exchange sets conforming to Edition 1.0.0 of S-131 may be dummy values (values that conform to the format requirements but are not actual signatures). Proper digital signatures will be mandatory when S-131 reaches Readiness Level 3 (cf. S-97 1.1.0 Clause A-5).

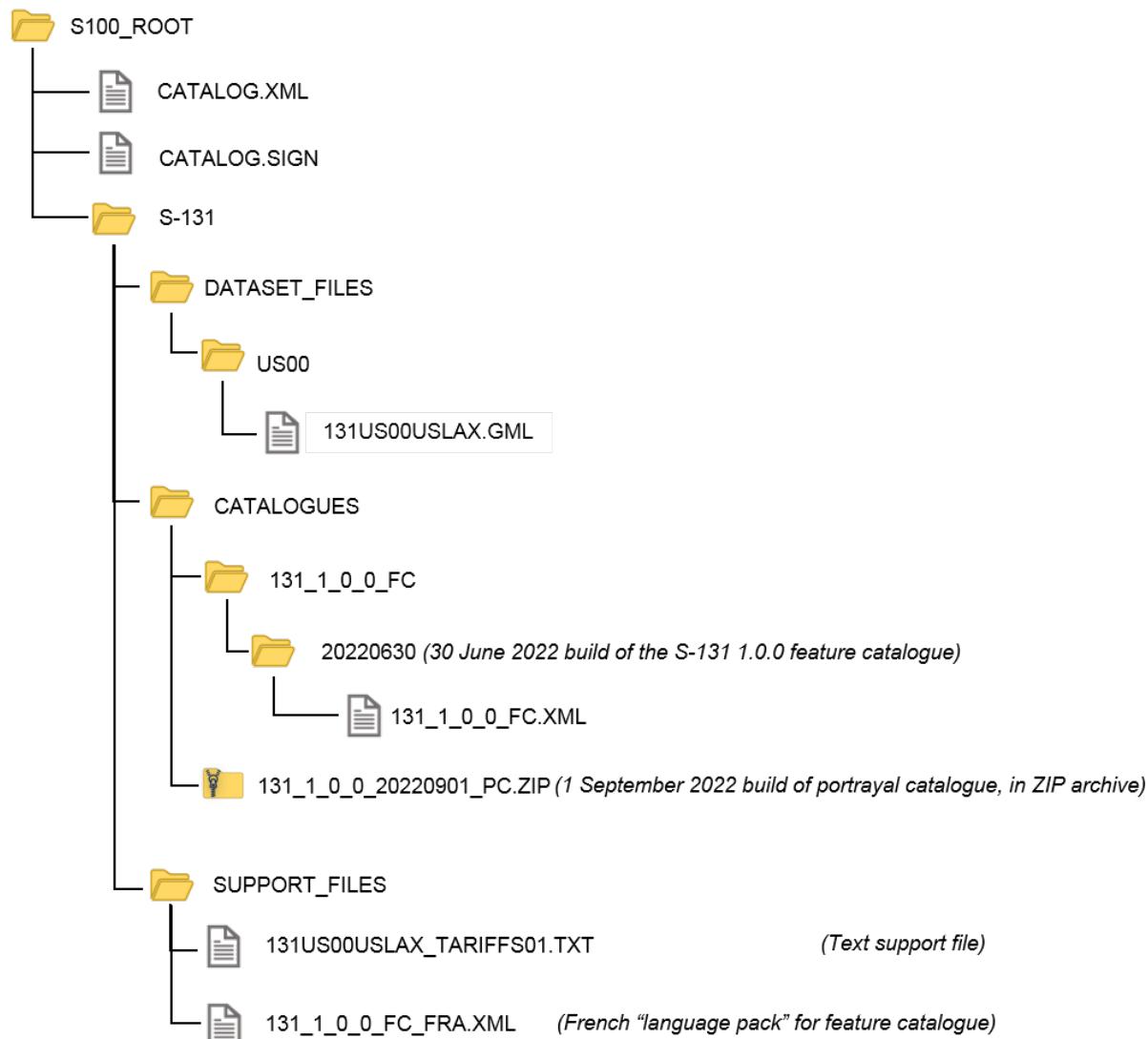


Figure 13-2 — Typical Exchange Set structure

13.5 Support files

Dataset support files offer supplementary information that can be included in an MHI Exchange Set.

- Plain text files must contain only general text as defined by this standard (text consisting only of printable characters and without HTML, XML, or other markup). The extension must be TXT.
- HTML files must contain only text and markup as defined in the relevant W3C standards. Files must use the UTF-8 character set encoding. References in datasets to HTML or text support files must treat them as text files (i.e., they should not be referenced using attributes intended for picture files). The extension must be HTM for HTML files and TXT for text files.
- Picture files must be in TIFF (6.0 specification) and use the extension TIF.
- XML files are allowed only for language packs and dictionaries such as the languages list included in the S-100 schema distribution²

Table 13-2 — Support file formats and extensions

File Types	Extensions	Comment
Text	TXT	Plain-text files
	HTM	HTML files must only include inline or embedded Cascading Style Sheet (CSS) information and must not contain embedded Javascript or other dynamic content, for example DHTML, Flash etc.
Picture	TIF	Baseline TIFF 6.0.

13.5.1 Support File Naming

All support files must have unique file identifiers. The support file metadata that accompanies the file will inform the user of the name and purpose of the file (that is new, replacement and deletion).

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

131CCCC000000000000.EEE

The main part forms an identifier where:

- 131—the first 3 characters identify the support file as applicable to an S-101 dataset (mandatory).
- CCCC—the fourth to seventh characters identify the Producer Code of the issuing agency (mandatory). Where the Producer Code is derived from a 2 or 3 character format (for instance when converting S-57 ENCs), the missing characters of the Producer Code must be populated with zeros (“00” or “0” respectively) for the sixth and seventh characters of the support file name, as required.
- 0000000000—the eighth and following characters are optional and can be used in any way by the Producer to provide the unique support 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. (TXT, HTM, TIF).
- The maximum length of the file name (including the extension and preceding ".") is 64 characters.

13.5.2 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. Three types: new, replacement and deletion are defined. 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 references the same file, before that file is deleted.

Each support file required must be included only once in the Exchange Set.

² The languages list, other dictionaries, language packs, and portrayal catalogue files are expected to be distributed separately in special exchange sets and should not be included in ordinary MHI exchange sets.

Support files must be stored in a separate folder within the Exchange Set, refer to [Figure 13-2](#)—Typical Exchange Set structure.

Re-use of a support file name after a deletion period is possible only if the support file edition number is higher than the previous edition number before deletion.

Only the latest edition of a support file can be used. As soon as a New Edition is created and installed, the older version is retired and can no longer be used by any feature.

If a support file is associated with multiple features in one or several datasets, a New Edition of the file will immediately be used by all associated features.

Picture and text files are treated differently with respect to changes not applicable to all features or information types referencing the support file.

- 1) **Picture files:** If a New Edition of a picture support file contains changes not applicable to all features or information type instances that reference the original picture, a completely new picture file must be created. Updates changing the file reference in the feature or information type instances that use the new picture must be generated and distributed as updates to the appropriate datasets.
- 2) **Text files:** The possibility that different feature or information type instances reference different portions of the file (by means of *fileLocator* attributes) must be taken into account.
 - a) For plain-text files (TXT), since users may see additional portions of the file as well as the specific section referenced, the same criteria as picture files must be applied and a new TXT file created if there are objects that still need the old information.
 - b) For HTML files, instances may have *fileLocator* attributes that point to either HTML “anchors” (i.e., bookmarks) or specific sections identified by an “id” attribute. If some instances still need to reference the old information, there are two possible solutions:
 - i) An updated support file can be created with the new information added in a new section of the file, identified by a new “HTML anchor” or “id” attribute. Feature and information type instances that need to reference the changed information must have their *fileLocator* values updated to reference the new section or bookmark.
 - ii) A new support file can be created and feature and information type instances that need to reference the new information must have their *fileReference* and *fileLocator* attributes updated.
 - c) If there are no *fileLocator* attributes in referencing instances, a new support file may be created or the existing support file may be updated to add the new information and facilitate locator attributes by adding HTML anchors or *id* attributes. The affected feature or information type instances must be updated accordingly.
- 3) In all cases, the file content must be reviewed and updated to ensure that there is no possibility of reader confusion. For example, if a regulation changes only for some regions, a sentence to the effect that “Revised for regions X, Y, and Z effective from (date)” may be added.

The potential necessity of appropriate changes in referencing instances should also be considered, for example to picture caption or *headline* attributes.

In deciding between options, producers should consider the expected lifetime of support files and the effects on update frequency for both datasets and support files, especially in connection with removal of obsolete information from the system as a whole as well as the removal of obsolete sections within support files.

13.6 Exchange Catalogue

The Exchange Catalogue acts as the table of contents for the Exchange Set. The Catalogue file of the Exchange Set must be named CATALOG.XML. No other file in the Exchange Set may be named CATALOG.XML. The contents of the S-131 Exchange Catalogue are described in clause [14](#).

13.7 Dataset loading

Datasets must always be loaded in the order of base dataset first, then update datasets in the corrected sequential order. Systems are not to load updates out of order, for example if update 1-5 is present, then 6 is missing, update 7 must not be loaded.

13.7.1 New editions

When a new edition of a dataset is received, the system must replace the previous edition, along with any updates with the new edition of the dataset. Loading of subsequent updates follows the same rule as above.

13.8 Data integrity and encryption

Signatures are required for datasets and exchange sets intended for use on ECDIS, as described in S-100 Parts 15 and 17. Datasets may be encrypted or unencrypted as determined by producer policy.

14 Metadata

14.1 Introduction

S-100 provides for supplying the following categories of metadata with S-100 based Exchange Sets:

- Metadata about the overall Exchange Set and the Exchange Catalogue;
- Discovery metadata about each of the datasets contained in the Exchange Set;
- Discovery metadata about the support files that make up the package;
- Metadata about any Feature, Portrayal, or Interoperability Catalogues included in the Exchange Set.

In an S-100 Exchange Set, the above metadata is provided by the Exchange Catalogue, which is an XML file containing XML blocks describing discovery metadata for the exchange set and its components.

The discovery metadata classes described in S-100 Part 17 have numerous attributes which enable important information about the datasets and accompanying support files to be examined without the need to process the data, for example, decrypt, decompress, load, etc. S-100 Figure 17-2 depicts the conceptual structure of an S-100 Exchange Set and the relationships between components of the Exchange Set and discovery metadata in the Exchange Catalogue. The Exchange Catalogue is structured as depicted in S-100 Figures 17-6 and 17-7. Detailed specifications for metadata are provided in S-100 clause 17-4.5.

Discovery metadata for each dataset is given in an XML block within the exchange set catalogue file, and can be accessed without opening the GML dataset file. Discovery metadata is described in clause [14.2](#).

This edition of S-131 implements the metadata structure and encoding defined in S-100 Edition 5.2.0 Part 17. This Edition of S-131 does not use ISO metadata files or Interoperability Catalogues. The optional discovery metadata which S-100 Part 17 provides for ISO metadata files and Interoperability Catalogues is therefore not permitted for S-131 data.

Since S-131 does not add product-specific metadata attributes, the S-100 metadata classes and schema are used in S-131 exchange sets without extension. The constraints S-131 imposes on generic S-100 metadata are included in clause [14.2](#), generally as remarks describing the extra conditions and restrictions imposed by S-131 (such as making an optional attribute mandatory).

In some cases (if provided by the producer or exchange set packager) the metadata may be repeated in a language other than English. See S-100 Part 17 Clauses 17-4.6—17-4.8 for guidance on encoding of metadata in languages other than English.

14.2 Elements of S-131 Exchange Catalogues

An outline of the overall concept of an S-131 exchange set for the interchange of geospatial data and its relevant metadata is explained in clause [13](#). The place of metadata in the exchange set is summarised in clause [13.1](#).

[Figure 14-1](#) depicts the structure of the exchange catalogue and its component discovery metadata blocks.

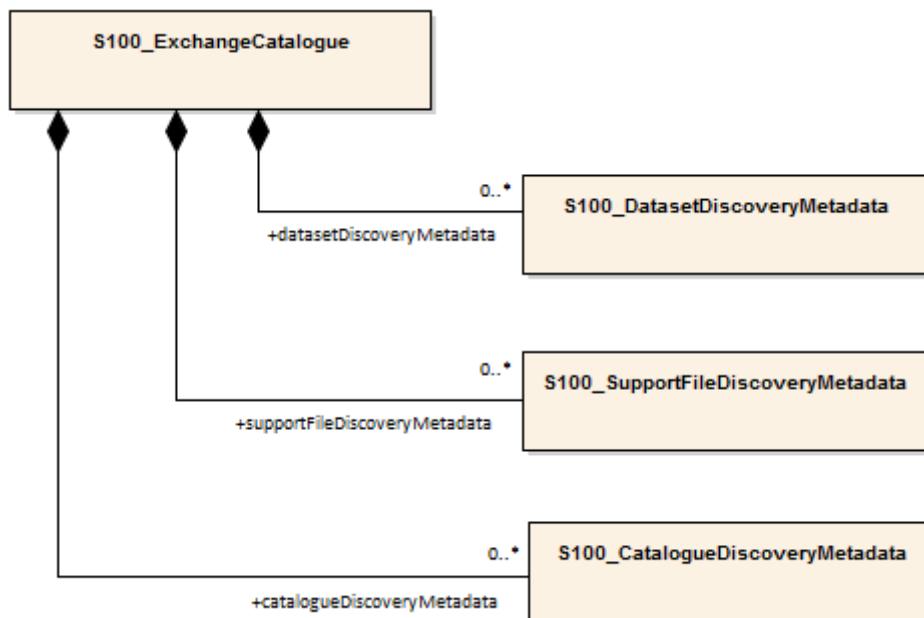


Figure 14-1 — Relationship between exchange catalogue, discovery metadata, and dataset (from S-100 5.2.0 Figure 17-6).

S-131 metadata in Exchange Catalogues is derived from S-100 Part 17, Figure 17-7, with the following restrictions:

- S-131 does not use certain optional elements and fields defined in S-100 generic metadata. Elements that are optional in the generic S-100 catalogue model but not used in S-131 are not shown.
- S-131 makes certain optional S-100 elements or fields mandatory. Elements that are optional in S-100 but mandatory in S-131 are shown with the restricted multiplicity in place of that given in S-100 Part 17 (for example, as “1” instead of the generic “0..1”) and the restriction is noted in the **Remarks** column.
- S-131 imposes certain product-specific requirements on the values of some metadata fields. These requirements are described in the **Remarks** column.
- In S-131 Edition 2.0.0 the only catalogues defined for S-131 products are Feature and Portrayal Catalogues.

The default language used by the Exchange Catalogue may be specified in the *defaultLocale* field of **S100_ExchangeCatalogue** (clause 0). If omitted, the default language is English. See S-100 Part 17, clauses 17-4.6 – 17-4.8 for guidance on encoding of metadata in languages other than English.

[Figure 14-2](#) depicts the detailed structure of the S-131 Exchange Catalogue. This Figure is derived from S-100 Part 17, Figure 17-7, modified to omit elements (classes, attributes, and enumeration values) that are optional in the generic S-100 catalogue model and not used in S-131.

The following clauses define the mandatory and optional metadata used by S-131. Differences from generic S-100 metadata are emphasized for developer convenience in bold text in the documentation tables, and comments noting the difference are included in the *Remarks* column. Where S-131 does not impose any restrictions on the S-100 class, the corresponding documentation table has been omitted from this document. In some cases the metadata may be repeated in a national language. If this is the case it is noted in the *Remarks* column.

In the following clauses, wherever S-131 makes an optional S-100 metadata attribute mandatory (that is, restricts multiplicity from 0.. to 1..), the restricted multiplicity is shown in place of the multiplicity given in S-100 Part 17. When this is done, the *Remarks* column contains a note about the restriction. Further, enumerations in the figure and the following clauses show only the values allowed in S-131 Exchange Catalogues. These differences from the S-100 generic metadata are in **bold** font.

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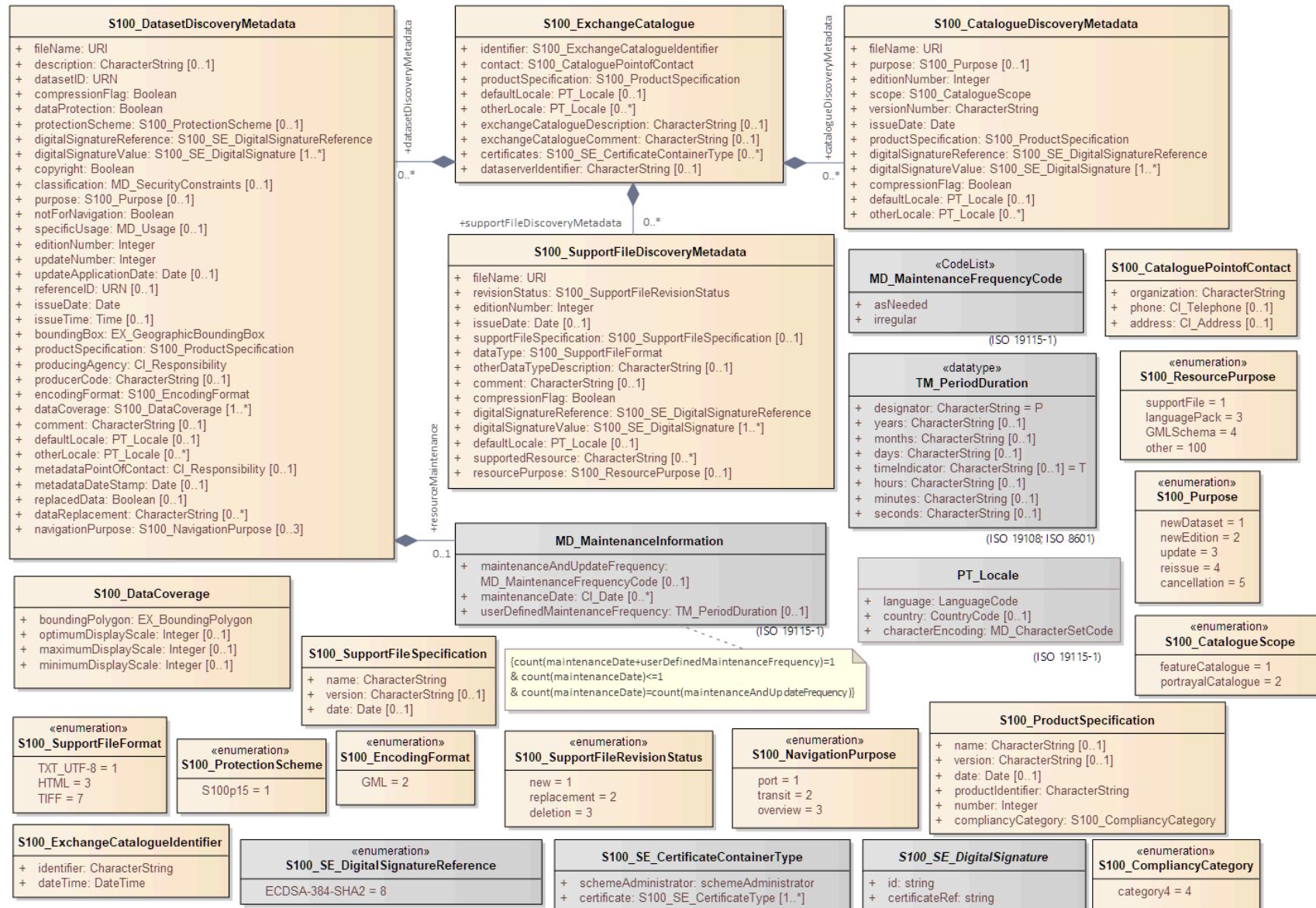


Figure 14-2 — Details of exchange set catalogue classes. (Derived from S-100 Figure 17-7.)

14.2.1 S100_ExchangeCatalogue

S-131 uses the S100_ExchangeCatalogue class with additional restrictions and constraints as described below.

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_ExchangeCatalogue	An exchange catalogue contains the discovery metadata about the exchange datasets and support files	-	-	The optional S-100 attributes <i>identifier</i> , <i>contact</i> , and <i>productSpecification</i> are mandatory in S-131.
Attribute	identifier	Uniquely identifies this exchange catalogue	1	S100_ExchangeCatalogueIdentifier	Mandatory in S-131.
Attribute	contact	Details about the issuer of this exchange catalogue	1	S100_CataloguePointOfContact	Mandatory in S-131.
Attribute	productSpecification	Details about the product specification used for the datasets contained in the exchange catalogue	1	S100_ProductSpecification	Mandatory in S-131.
Attribute	defaultLocale	Default language and character set used for all metadata records in this Exchange Catalogue	0..1	PT_Locale	Default is English and UTF-8
Attribute	otherLocale	Other languages and character sets used for the localized metadata records in this Exchange Catalogue	0..*	PT_Locale	Required if any localized entries are present in the Exchange Catalogue
Attribute	exchangeCatalogueDescription	Description of what the exchange catalogue contains	0..1	CharacterString	
Attribute	exchangeCatalogueComment	Any additional Information	0..1	CharacterString	
Attribute	certificates	Signed public key certificates referred to by digital signatures in the Exchange Set	0..*	S100_SE_CertificateContainer	Content defined in S-100 Part 15. All certificates used, except the SA root certificate (installed separately by the implementing system) shall be included

Role Name	Name	Description	Mult	Type	Remarks
Attribute	dataServerIdentifier	Identifies the data server for the permit	0..1	CharacterString	
Role	datasetDiscoveryMetadata	Exchange Catalogues may include or reference discovery metadata for the datasets in the Exchange Set	0..*	Aggregation S100_DatasetDiscoveryMetadata	
Role	catalogueDiscoveryMetadata	Metadata for Catalogue	0..*	Aggregation S100_CatalogueDiscoveryMetadata	Metadata for the Feature, Portrayal and Interoperability Catalogues, if any
Role	supportFileDiscoveryMetadata	Exchange Catalogues may include or reference discovery metadata for the support files in the Exchange Set	0..*	Aggregation S100_SupportFileDiscoveryMetadata	

14.2.1.1 S100_ExchangeCatalogueIdentifier

S-131 uses the S100_ExchangeCatalogueIdentifier class without modification.

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_ExchangeCatalogueIdentifier	An identifier for an Exchange Catalogue.	-	-	-
Attribute	identifier	Uniquely identifies this Exchange Catalogue	1	CharacterString	E.g., US00131_JS04003_20200101
Attribute	dateTime	Creation date and time of the Exchange Catalogue, including time zone	1	DateTime	Format: yyyy-mm-ddThh:mm:ssZ

14.2.1.2 S100_CataloguePointOfContact

S-131 uses the S100_CataloguePointOfContact class without modification.

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_CataloguePointOfContact	Contact details of the issuer of this Exchange Catalogue	-	-	-
Attribute	organization	The organization distributing this Exchange Catalogue	1	CharacterString	This could be an individual producer, value added reseller, etc
Attribute	phone	The phone number of the organization	0..1	CI_Telephone	
Attribute	address	The address of the organization	0..1	CI_Address	

14.2.2 S100_DatasetDiscoveryMetadata

S-131 restricts the multiplicity and contents of S100_DatasetDiscoveryMetadata as described in the table below.

Dataset discovery metadata for an update dataset also uses S100_DatasetDiscoveryMetadata. Update dataset metadata is intended to describe information about an update dataset. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of an update dataset. Whereas dataset metadata is usually fairly comprehensive, metadata for update datasets only describe the issue date and sequential relation to the base dataset. Optional fields may therefore be omitted for update metadata unless mandated in the **Remarks** column.

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_DatasetDiscoveryMetadata	Metadata about the individual datasets in the exchange catalogue	-	-	The optional S-100 attributes <i>datasetID</i>, <i>editionNumber</i>, <i>updateNumber</i>, <i>dataCoverage</i> and <i>boundingBox</i> are mandatory in S-131. The optional S-100 attribute <i>temporalExtent</i> is not used.
Attribute	fileName	Dataset file name	1	URI	See S-100 Part 1, clause 1-4.6
Attribute	description	Short description giving the area or location covered by the dataset	0..1	CharacterString	E.g. a harbour or port name, between two named locations etc.
Attribute	datasetID	Dataset ID expressed as a Marine Resource Name	1	URN	The URN must be an MRN. Restricted to mandatory in S-131
Attribute	compressionFlag	Indicates if the resource is compressed	1	Boolean	<i>true</i> indicates a compressed dataset resource

Role Name	Name	Description	Mult	Type	Remarks
					<i>false</i> indicates an uncompressed dataset resource
Attribute	dataProtection	Indicates if the data is encrypted	1	Boolean	<i>true</i> indicates an encrypted dataset resource <i>false</i> indicates an unencrypted dataset resources
Attribute	protectionScheme	Specification of method used for data protection	0..1	S100_ProtectionScheme	In S-100 Edition 5.2.0 the only allowed value is "S100p15".
Attribute	digitalSignatureReference	Specifies the algorithm used to compute digitalSignatureValue	1	S100_DigitalSignatureReference (see S-100 Part 15)	
Attribute	digitalSignatureValue	Value derived from the digital signature	1..*	S100_DigitalSignatureValue (see S-100 Part 15)	The value resulting from application of <i>digitalSignatureReference</i> . Implemented as the digital signature format specified in Part 15. There must be at least one signature on the file as included in the exchange set. See Note 2 below.
Attribute	copyright	Indicates if the dataset is copyrighted	1	Boolean	<i>true</i> indicates the resource is copyrighted <i>false</i> Indicates the resource is not copyrighted
Attribute	classification	Indicates the security classification of the dataset	0..1	MD_SecurityConstraints> MD_ClassificationCode (codelist)	<ol style="list-style-type: none"> 1) unclassified 2) restricted 3) confidential 4) secret 5) top secret 6) sensitive but unclassified 7) for official use only 8) protected 9) limited distribution
Attribute	purpose	The purpose for which the dataset has been issued	0..1	S100_Purpose	
Attribute	notForNavigation	Indicates the dataset is not intended to be used for navigation	1	Boolean	<i>true</i> indicates the dataset is not intended to be used for navigation <i>false</i> indicates the dataset is intended to be used for navigation

Role Name	Name	Description	Mult	Type	Remarks
Attribute	specificUsage	The use for which the dataset is intended	1	MD_USAGE>specificUsage (character string)	Information about specific usage(s) for which the dataset is intended. The string value “general” may be encoded if there is no specific usage.
Attribute	editionNumber	The edition number of the dataset	1	Integer	Mandatory in S-131.
Attribute	updateNumber	Update number assigned to the dataset and increased by one for each subsequent update	1	Integer	Update number 0 is assigned to a new dataset Made mandatory in S-131.
Attribute	updateApplicationDate	This date is only used for the base cell files (that is new data set, 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	This date is only used for the base dataset files (that is new dataset, re-issue and new edition), not update dataset files. All updates dated on or before this date must have been applied by the producer
Attribute	referenceID	Reference back to the datasetID	0..1	URN	Update metadata refers to the datasetID of the dataset metadata. This is used if and only if the dataset is an updateThe URN must be an MRN
Attribute	issueDate	Date on which the data was made available by the data producer	1	Date	
Attribute	issueTime	Time of day at which the data was made available by the data producer	0..1	Time	Mandatory when the interval between datasets is shorter than 1 day, such as 6-hourly forecasts.
Attribute	boundingBox	The extent of the dataset limits	1	EX_GeographicBoundingBox	Mandatory in S-131.
Attribute	productSpecification	The product specification used to create this dataset	1	S100_ProductSpecification	
Attribute	producingAgency	Agency responsible for producing the data	1	CI_ResponsibleParty>CI_Organisation	See S-100 Table 17-3
Attribute	producerCode	The official IHO Producer Code from S-62	0..1	CharacterString	
Attribute	encodingFormat	The encoding format of the dataset	1	S100_EncodingFormat	Must be GML
Attribute	dataCoverage	Area covered by the dataset	1..*	S100_DataCoverage	Mandatory in S-131.

Role Name	Name	Description	Mult	Type	Remarks
Attribute	comment	Any additional information	0..1	CharacterString	
Attribute	defaultLocale	Default language and character set used in the exchange catalogue	1	PT_Locale	
Attribute	otherLocale	Other languages and character sets used in the exchange catalogue	0..*	PT_Locale	
Attribute	metadataFileIdentifier	Identifier for metadata file	1	CharacterString	For example, for ISO 19115-3 metadata file
Attribute	metadataPointOfContact	Point of contact for metadata	0..1	CI_Responsibility > CI_Individual or CI_Responsibility > CI_Organisation	Only if metadataPointOfContact is different from producingAgency. See S-100 Tables 17-2 and 17-3.
Attribute	metadataTimeStamp	Date stamp for metadata	0..1	Date	May or may not be the issue date of the dataset.
Attribute	replacedData	If a data file is cancelled is it replaced by another data file	0..1	Boolean	See Note 1
Attribute	dataReplacement	Dataset name	0..*	CharacterString	A dataset may be replaced by 1 or more datasets See Note 1
Attribute	navigationPurpose	Classification of intended navigation purpose (for Catalogue indexing purposes)	0..3	S100_NavigationPurpose	Mandatory when <i>notForNavigation = false</i> .
Role	resourceMaintenance	Information about the frequency of resource updates, and the scope of those updates	0..1	MD_MaintenanceInformation	S-100 restricts the multiplicity to 0..1 and adds specific restrictions on the ISO 19115 structure and content. See clause MD_MaintenanceInformation in S-100 Part 17. Format: PnYnMnDTnHnMs (XML built-in type for ISO 8601 duration). See S-100 clause 17-4.9 for encoding guidance.

NOTE 1: replacedData and dataReplacement: The intended use of the attributes replacedData and dataReplacement could be, for example, to provide a mechanism for service providers to build automation when providing replacement data sets to customers within existing subscription periods.

NOTE 2: For each file in the Exchange Set (datasets, support files, and catalogues) this signature is mandatory and signs the file as it is stored in the Exchange Set. Thus, if the file is compressed and/or encrypted this signature must be created after any compression and encryption. Other signatures may be added but are not required. They can use either the type S100_SE_SignatureOnData or S100_SE_SignatureOnSignature. The mandatory attribute dataStatus must be set to the appropriate value for S100_SE_SignatureOnData.

14.2.2.1 S100_NavigationPurpose

S-131 uses the S100_NavigationPurpose enumeration without modification.

Role Name	Name	Description	Code	Remarks
Enumeration	S100_NavigationPurpose	The purpose of the dataset	-	
Value	port	For port and near shore operations	1	-
Value	transit	For coast and planning purposes	2	-
Value	overview	For ocean crossing and planning purposes	3	-

14.2.2.2 S100_DataCoverage

S-131 uses the S100_DataCoverage class with additional restrictions and constraints as described below..

Name	Description	Multiplicity	Type	Remarks
S100_DataCoverage	A spatial extent where data is provided; and the display scale information for the provided data	-	-	The optional S-100 attributes <i>temporalExtent</i> and <i>approximateGridResolution</i> are not used in S-131.
boundingPolygon	A polygon which defines the actual data limit	1	EX_BoundingPolygon	(see Note)
optimumDisplayScale	The scale with which the data is optimally displayed	0..1	Integer	Example: A scale of 1:25000 is encoded as 25000
maximumDisplayScale	The maximum scale with which the data is displayed	0..1	Integer	Must be one of the following values: 1000 2000 3000 4000 8000 12000 22000

Name	Description	Multiplicity	Type	Remarks
				45000 90000 180000 350000 700000 1500000 3500000 10000000
minimumDisplayScale	The minimum scale with which the data is displayed	0..1	Integer	Must be one of the following values: 2000 3000 4000 8000 12000 22000 45000 90000 180000 350000 700000 1500000 3500000 10000000

NOTE: *boundingPolygon* is restricted to a single GML Polygon with one exterior and 0 or more interiors expressed as Linear Rings using SRS EPSG code 4326 in http URI format. The exterior and optional interiors shall be composed of a closed sequence of >=4 coordinate positions expressed as a list (<posList>). The GML polygon shall have a valid GML identifier. Coordinate order must always be as per the CRS.

14.2.2.3 S100_Purpose

S-131 uses the S100_Purpose enumeration with additional restrictions as described below..

Role Name	Name	Description	Code	Remarks
Enumeration	S100_Purpose	The purpose of the dataset	-	The value delta is not used.
Value	newDataset	Brand new dataset	1	No data has previously been produced for this area or there is a significant change from the existing, for example, coverage or extent

Role Name	Name	Description	Code	Remarks
Value	newEdition	New edition of the dataset or Catalogue	2	Includes new information which has not been previously distributed by updates
Value	update	Dataset update	3	Changing some information in an existing dataset
Value	reissue	Dataset that has been re-issued	4	Includes all the updates applied to the original dataset up to the date of the re-issue. A re-issue does not contain any new information additional to that previously issued by updates
Value	cancellation	Dataset or Catalogue that has been cancelled	5	Indicates the dataset or Catalogue should no longer be used and can be deleted

14.2.2.4 S100_EncodingFormat

S-131 uses the S100_EncodingFormat enumeration with additional restrictions as described below..

Role Name	Name	Description	Code	Remarks
Enumeration	S100_EncodingFormat	The encoding format	-	Values listed in S-100 Part 17 but not mentioned in this table are not allowed
Value	GML	The GML data format as defined in S-100 Part 10b		

14.2.2.5 S100_ProductSpecification

S-131 uses the S100_ProductSpecification class with additional restrictions and constraints as described below..

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_ProductSpecification	The Product Specification contains the information needed to build the specified product	-	-	The attribute <i>compliancyCategory</i> is made mandatory.
Attribute	name	The name of the Product Specification used to create the datasets	0..1	CharacterString	Marine Harbour Infrastructure

Role Name	Name	Description	Mult	Type	Remarks
Attribute	version	The version number of the Product Specification	0..1	CharacterString	2.0.0
Attribute	date	The version date of the Product Specification	0..1	Date	
Attribute	productIdentifier	Machine readable unique identifier of a product type	1	CharacterString (Restricted to Product ID values from the IHO Product Specification Register, in the IHO Geospatial Information (GI) Registry)	"S-131" (without quotes)
Attribute	number	The number (registry index) used to lookup the product in the Product Specification Register	1	Integer	From the Product Specification Register in the IHO Geospatial Information (GI) Registry
Attribute	compliancyCategory	The level of compliance of the Product Specification to S-100	1	S100_CompliancyCategory	Needed for S-98 interoperability.

14.2.2.6 S100_CompliancyCategory

S-131 uses the S100_CompliancyCategory enumeration with a restricted set of values as described below.

Role Name	Name	Description	Code	Remarks
Enumeration	S100_CompliancyCategory		-	S-131 uses only category4
Value	category4	IHO S-100 and IMO harmonized display compliant		

14.2.2.7 S100_ProtectionScheme

S-131 uses the S100_ProtectionScheme enumeration without modification.

Role Name	Name	Description	Code	Remarks
Enumeration	S100_ProtectionScheme	Data protection schemes	-	-
Value	S100p15	IHO S-100 Part 15	-	See S-100 Part 15

14.2.3 S100_SupportFileDiscoveryMetadata

S-131 uses the S100_SupportFileDiscoveryMetadata class without modification.

Role Name	Name	Description	Mult.	Type	Remarks
Class	S100_SupportFileDiscoveryMetadata	Metadata about the individual support files in the Exchange Catalogue	-	-	
Attribute	fileName	Name of the support file	1	URI	See S-100 Part 1, clause 1-4.6
Attribute	revisionStatus	The purpose for which the support file has been issued	1	S100_SupportFileRevisionStatus	For example new, replacement, etc
Attribute	editionNumber	The Edition number of the support file	1	Integer	When a support file is initially created, the Edition number 1 is assigned to it. The Edition number is increased by 1 when the support file content changes and initiates a new edition of the support file.
Attribute	issueDate	Date on which the data was made available by the Data Producer	0..1	Date	Date on which the support file was made available by its producer.
Attribute	supportFileSpecification	The specification used to create this file	0..1	S100_SupportFileSpecification	May be omitted for language packs.
Attribute	dataType	The format of the support file	1	S100_SupportFileFormat	
Attribute	otherDataTypeDescription	Support file format other than those listed	0..1	CharacterString	
Attribute	comment	Optional comment	0..1	CharacterString	
Attribute	compressionFlag	Indicates if the resource is compressed	1	Boolean	<i>true</i> indicates a compressed resource <i>false</i> indicates an uncompressed resource
Attribute	digitalSignatureReference	Specifies the algorithm used to compute digitalSignatureValue	1	S100_DigitalSignatureReference (see S-100 Part 15)	

Role Name	Name	Description	Mult.	Type	Remarks
Attribute	digitalSignatureValue	Value derived from the digital signature	1..*	S100_DigitalSignatureValue(see Part 15)	The value resulting from application of digitalSignatureReference. Implemented as the digital signature format specified in S-100 Part 15. There must be at least one signature on the file as included in the exchange set.
Attribute	defaultLocale	Default language and character set used in the support file	0..1	PT_Locale	In absence of defaultLocale the language is English in UTF-8A support file is expected to use only one as locale. Additional support files can be created for other locales.
Attribute	supportedResource	Identifier of the resource supported by this support file	0..*	CharacterString	Conventions for identifiers are detailed in S-100 Part 15. S-100 allows file URI, digital signature or cryptographic hash checksums to be used.
Attribute	resourcePurpose	The purpose of the supporting resource	0..1	S100_ResourcePurpose	Identifies how the supporting resource is used

14.2.3.1 S100_SupportFileFormat

S-131 uses the S100_SupportFileFormat enumeration with a restricted set of values as described below.

Role Name	Name	Description	Code	Remarks
Enumeration	S100_SupportFileFormat	The format used for the support file	-	Values listed in S-100 Part 17 but not mentioned in this table are not allowed
Value	TXT_UTF-8	UTF-8 text excluding control codes	1	Text
Value	HTML	Hypertext Markup Language	3	
Value	TIFF	Tagged Image File Format	7	

14.2.3.2 S100_SupportFileRevisionStatus

S-131 uses the S100_SupportFileRevisionStatus enumeration without modification.

Role Name	Name	Description	Code	Remarks
Enumeration	S100_SupportFileRevisionStatus	The reason for inclusion of the support file in this exchange set	-	-
Value	new	A file which is new	1	Signifies a new file
Value	replacement	A file which replaces an existing file	2	Signifies a replacement for a file of the same name
Value	deletion	Deletes an existing file	3	Signifies deletion of a file of that name

14.2.3.3 S100_SupportFileSpecification

S-131 uses the S100_SupportFileSpecification class without modification.

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_SupportFileSpecification	The standard or specification to which a support file conforms	-	-	-
Attribute	name	The name of the specification used to create the support file	1	CharacterString	
Attribute	version	The version number of the specification	0..1	CharacterString	
Attribute	date	The version date of the specification	0..1	Date	

14.2.3.4 S100_ResourcePurpose

S-131 uses the S100_ResourcePurpose enumeration with a restricted set of values as described below.

Role Name	Name	Description	Code	Remarks
Enumeration	S100_ResourcePurpose	Defines the purpose of the supporting resource	-	The value ISOMetadata is prohibited
Value	supportFile	A support file	1	
Value	languagePack	A Language pack	3	
Value	GMLSchema	GML Application Schema	4	
Value	other	A type of resource not otherwise described	100	

14.2.4 S100_CatalogueDiscoveryMetadata

This is an optional element that allows for the delivery of S-131 Feature and Portrayal Catalogues within an Exchange Set.

S-131 uses the S100_CatalogueDiscoveryMetadata class without modification.

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_CatalogueDiscoveryMetadata	Class for S-100 Catalogue metadata	-	-	-
Attribute	fileName	The name for the Catalogue	1	URI	See S-100 Part1, clause 1-4.6
Attribute	purpose	The purpose for which the Catalogue has been issued	0..1	S100_Purpose(codelist)	The values must be one of the following: 2: new edition 5: cancellation Default is new edition
Attribute	editionNumber	The Edition number of the Catalogue	1	Integer	Initially set to 1 for a given productSpecification. numberIncreased by 1 for each subsequent newEditionUniquely identifies the version of the Catalogue
Attribute	scope	Subject domain of the Catalogue	1	S100_CatalogueScope	
Attribute	versionNumber	The version identifier of the Catalogue	1	CharacterString	Human readable version identifier
Attribute	issueDate	The issue date of the Catalogue	1	Date	
Attribute	productSpecification	The Product Specification used to create this file	1	S100_ProductSpecification	
Attribute	digitalSignatureReference	Specifies the algorithm used to compute digitalSignatureValue	1	S100_DigitalSignatureReference(see S-100 Part 15)	
Attribute	digitalSignatureValue	Value derived from the digital signature	1..*	S100_DigitalSignatureValue(see S-100 Part 15)	The value resulting from application of <i>digitalSignatureReference</i> Implemented as the digital signature format specified in Part 15. There must be

Role Name	Name	Description	Mult	Type	Remarks
					at least one signature on the file as included in the exchange set.
Attribute	compressionFlag	Indicates if the resource is compressed	1	Boolean	<i>true</i> indicates a compressed resource <i>false</i> indicates an uncompressed resource
Attribute	defaultLocale	Default language and character set used in the Catalogue	0..1	PT_Locale	In absence of <i>defaultLocale</i> the language is English in UTF-8
Attribute	otherLocale	Other languages and character sets used in the Catalogue	0..*	PT_Locale	

14.2.4.1 S100_CatalogueScope

S-131 uses the S100_CatalogueScope enumeration with a restricted set of values as described below.

Role Name	Name	Description	Code	Remarks
Enumeration	S100_CatalogueScope	The scope of the Catalogue	-	Interoperability Catalogues are not implemented
Value	featureCatalogue	S-100 Feature Catalogue	1	
Value	portrayalCatalogue	S-100 Portrayal Catalogue	2	

14.2.5 Miscellaneous metadata types

14.2.5.1 MD_MaintenanceInformation

S-131 uses MD_MaintenanceInformation with the restrictions and constraints specified in S-100.

Role Name	Name	Description	Mult	Type	Remarks
Class	MD_MaintenanceInformation	Information about the scope and frequency of updating	-	-	S-100 restricts the ISO 19115-class to: <ul style="list-style-type: none">• prohibit maintenanceScope, maintenanceNote, and contact attributes;

Role Name	Name	Description	Mult	Type	Remarks
					<ul style="list-style-type: none"> define restrictions on maintenanceAndUpdateFrequency, maintenanceDate, and userDefinedMaintenanceFrequency attributes
Attribute	maintenanceAndUpdateFrequency	Frequency with which changes and additions are made to the resource after the initial resource is completed	0..1	MD_MaintenanceFrequencyCode (codelist)	Must be populated if userDefinedMaintenanceFrequency is not present, otherwise optional. See Table MD_MaintenanceFrequencyCode in this Part for values allowed in S-100 metadata
Attribute	maintenanceDate	Date information associated with maintenance of the resource	0..1	CI_Date	Exactly one of maintenanceDate and userDefinedMaintenanceFrequency must be populated. Allowed value for dateType: nextUpdate
Attribute	userDefinedMaintenanceFrequency	Maintenance period other than those defined	0..1	TM_PeriodDuration	Exactly one of maintenanceDate and userDefinedMaintenanceFrequency must be populated. Only positive durations allowed

14.2.5.2 MD_MaintenanceFrequencyCode

S-100 uses a subset of the values allowed in [ISO 19115-1](#).

S-131 uses MD_MaintenanceFrequencyCode with the restrictions and constraints specified in S-100.

Role Name	Name	Description	Code	Remarks
Enumeration	MD_MaintenanceFrequencyCode	Frequency with which modifications and deletions are made to the data after it is first produced	-	S-100 is restricted to only the following values from the ISO 19115-1 codelist. The conditions for the use of a particular value are described in its Remarks
Value	asNeeded	Resource is updated as deemed necessary	1	Use only for datasets which normally use a regular interval for update or supersession, but will have the next update issued at an interval different from the usualAllowed if and only if userDefinedMaintenanceFrequency is not populated
Value	irregular	Resource is updated in intervals that are uneven in duration	2	Use only for datasets which do not use a regular schedule for update or supersessionAllowed if and only if userDefinedMaintenanceFrequency is not populated

14.2.5.3 PT_Locale

S-131 uses PT_Locale with the restrictions and constraints specified in S-100.

Role Name	Name	Description	Mult	Type	Remarks
Class	PT_Locale	description of a locale	-	-	From ISO 19115-1
Value	language	designation of the locale language	1	LanguageCode	ISO 639-2 3-letter language codes.
Value	country	designation of the specific country of the locale language	0..1	CountryCode	ISO 3166-2 2-letter country codes
Value	characterEncoding	designation of the character set to be used to encode the textual value of the locale	1	MD_CharacterSetCode	UTF-8 is used in S-100

The class PT_Locale is defined in [ISO 19115-1](#). LanguageCode, CountryCode, and MD_CharacterSetCode are ISO codelists which are defined in a resource file in the S-100 5.0 schemas distribution.

14.2.5.4 EX_GeographicBoundingBox

From [ISO 19115-1](#).

S-131 uses EX_GeographicBoundingBox with the restrictions and constraints specified in S-100.

Role Name	Name	Description	Mult	Type	Remarks
Class	EX_GeographicBoundingBox	geographic position of the dataset	-	-	Defined in ISO 19115-1 : geographic position of the resource.
Attribute	westBoundLongitude	western-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)	1	Real	Arc degrees
Attribute	eastBoundLongitude	eastern-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)	1	Real	Arc degrees
Attribute	southBoundLatitude	southern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)	1	Real	Arc degrees

Role Name	Name	Description	Mult	Type	Remarks
Attribute	northBoundLatitude	northern-most coordinate of the limit of the dataset extent expressed in latitude in decimal degrees (positive north)	1	Real	Arc degrees

14.2.5.5 EX_BoundingPolygon

From [ISO 19115-1](#).

Role Name	Name	Description	Mult	Type	Remarks
Class	EX_BoundingPolygon	boundary enclosing the dataset, expressed as the closed set of (x,y) coordinates of the polygon (last point replicates first point)	-	-	Defined in ISO 19115-1 : enclosing geometric object which locates the resource, expressed as a set of (x,y) coordinate(s)
Attribute	polygon	sets of points defining the bounding polygon	1	GM_Object	Must be a GM_Polygon (See S-100 Part 7, ISO 19107, ISO 19136)

14.2.6 Types for digital signatures

The types relating to digital signatures:

- S100_SE_CertificateContainer
- S100_SE_DigitalSignatureReference
- S100_SE_DigitalSignatureValue
- S100_SE_SignatureOnData
- S100_SE_SignatureOnSignature
- DataStatus

are defined in S-100 Part 15 and are used in S-131 without modification.

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14.3 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 **featureName**.

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

15 LIST OF ANNEXES

These Annexes are separate files and can be found either in the S-131 Product Specification distribution package or at the locations indicated.

- Annex A Data Classification and Encoding Guide. Separate document. IHO Geospatial Information Registry, <https://registry.ihodata.int>
- Annex B Encoding Format. GML schema, Schematron rule files, and schema documentation. S-100 schema server, <https://schemas.s100dev.net>.
- Annex C Feature catalogue. XML file. IHO Geospatial Information Registry, <https://registry.ihodata.int>
- Annex D Portrayal Catalogue. Zip archive of portrayal catalogue. IHO Geospatial Information Registry, <https://registry.ihodata.int>

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