

INTERNATIONAL HYDROGRAPHIC ORGANIZATION



MARINE RADIO SERVICES PRODUCT SPECIFICATION

IHO Publication S-123

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4b quai Antoine 1^{er}
Principauté de Monaco
Tel: (377) 93.10.81.00
Fax: (377) 93.10.81.40
E-mail: info@iho.int
Web: www.iho.int

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Revision History

Changes to this Product Specification are coordinated by the IHO Nautical Information Provision Working Group (NIPWG). New editions will be made available via the IHO web site. Maintenance of the Product Specification shall conform to IHO Technical Resolution 2/2007 (revised 2010).

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| 1.0.0 draft 2 | 2017/07/14 | EM | Apply revisions from NIPWG review |
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1 Overview

1.1 Introduction

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 primarily intended for encoding the extent and nature of Radio Services, for navigational purposes.

Radio services describe the availability and reliability of radio stations and services offering navigational warnings and weather forecasts. This includes their service areas, services offered and instructions for contacting or utilizing these services.

2 References

2.1 Normative

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

IHO S-100 IHO Universal Hydrographic Data Model Edition 3.0.0 (April 2017).

ISO 8601. 2004. *Data elements and interchange formats - Information interchange - Representation of dates and times*. 2004.

ISO 3166-1. 1997. *Country Codes*. 1997.

ISO 19101-2:2008 Geographic Information - Rules for Application Schema

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

ISO 19106:2004 Geographic Information – Profiles

ISO 19107:2003 Geographic Information – Spatial schema

ISO 19109:2005 Geographic Information - Rules for Application Schema

ISO 19111:2003 Geographic Information - Spatial referencing by coordinates

ISO 19115:2003+Corr1 (2006) Geographic Information - Metadata

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

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

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

ISO 19131:2007 Geographic Information - Data product specifications

ISO 19136:2007 Geographic Information – Geography Markup Language

ISO 19136-2:2015, Geographic Information – Geography Markup Language.

ISO/TS 19139, Geographic Information – Metadata – XML schema implementation.

2.2 Informative

The following informative documents provide additional information, including background information, but are not required to develop applications for data conforming to this specification.

ISO/IEC 19757-3, Information technology – Document Schema Definition Languages (DSDL) – Part 3: Rule-based validation – Schematron.

IHO S-101 IHO Electronic Navigational Chart Product Specification (release date TBD).

3 Terms, Definitions and Abbreviations

3.1 Terms and Definitions

The S-100 framework is based on the ISO 19100 series of geographic standards. The terms and definitions provided here are used to standardize the nomenclature found within that framework,

whenever possible. They are taken from the references cited in clause 2.1. Modifications have been made when necessary.

application

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

application schema

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

conceptual model

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

conceptual schema

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

coverage

feature that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal **domain** (ISO 19123)

EXAMPLE Raster image, polygon overlay, digital elevation matrix.

data product

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

data product specification

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

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

dataset

identifiable collection of data (ISO 19115)

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

dataset series

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

domain

well-defined set (ISO/TS 19103)

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

feature

abstraction of real world phenomena (ISO 19101)

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

feature association

relationship that links instances of one **feature** type with instances of the same or a different **feature** type (ISO19110)

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

NOTE 2: Feature associations include aggregation of features.

feature attribute

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

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

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

geographic data

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

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

metadata

data about data (ISO 19115)

model

abstraction of some aspects of reality (ISO 19109)

portrayal

presentation of information to humans (ISO 19117)

quality

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

universe of discourse

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

3.2 Abbreviations

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

ASCII American Standard Code for Information Interchange
 ECDIS Electronic Chart Display and Information Systems
 ENC Electronic Navigational Chart
 GML Geography Markup Language
 IHO International Hydrographic Organization
 IOC International Oceanographic Commission
 ISO International Organization for Standardization
 MIO Marine Information Overlay
 NIPWG Nautical Information Provision Working Group
 NPIO Nautical Publication Information Overlay
 UML Unified Modelling Language
 URI Uniformed Resource Identifier

| | |
|------|--|
| URL | Uniform Resource Locator |
| WMS | Web Map Service |
| WFS | Web Feature Service |
| www | World Wide Web |
| WGS | World Geodetic System |
| XML | Extensible Markup Language |
| XSLT | eXtensible Stylesheet Language Transformations |

3.3 Use of Language

Within this document, including appendices and annexes:

- “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.

3.4 UML Notations

In this document, conceptual schemas are presented in the Unified Modelling Language (UML). Several model elements used in this schema are defined in ISO standards or in IHO S-100 documents. In order to ensure that class names in the model are unique ISO TC/211 has adopted a convention of establishing a prefix to the names of classes that define the TC/211 defined UML package in which the UML class is defined. The IHO standards and this product specification make use of classes derived directly from the ISO standards. This convention is also followed in this document. In the IHO standards class names are identified by the name of the standard, such as "S100" as the prefix optionally followed by the bi-alpha prefix derived from ISO standard. In order to avoid having multiple classes instantiating the same root classes, the ISO classes and S-100 classes have been used where possible; however, a new instantiated class is required if there is a need to alter a class or relationship to prevent a reverse coupling between the model elements introduced in this document and those defined in S-100 or the ISO model.

Association links are given different colors only in order to distinguish links that cross in some diagrams. There is no semantic significance attached to link colors in this document.

4 Specification Description

4.1 Informal Description of Data Product

This clause contains general information about the data product.

Title: Marine Radio Services Product Specification.

Abstract: Marine radio services product specification describe the means to capture availability and reliability of radio stations, radio position fixing systems, radio beacons, services offering navigational warnings and weather forecasts in the maritime domain. This may include details on the service areas, services offered and instructions for contacting or utilizing these services.

Content: Datasets conforming to this specification will contain all relevant maritime radio service information for the area of coverage.

Additionally, there will be relevant metadata data quality, production authority, data sources and publication date.

Spatial Extent: Global coverage of maritime areas.

Specific Purpose: Describing radio services in the maritime domain for utilization in ECDIS, and to allow the producer to exchange radio services information with interested stakeholders.

4.2 Data product specification metadata

This information uniquely identifies this Product Specification and provides information about its creation and maintenance. For further information on dataset metadata see the metadata clause.

Title: Marine Radio Services

S-100 Version: 3.0.0

S-123 Version: 1.0.0

Date: January 2019

Language: English

Classification: Unclassified

Contact: International Hydrographic Organization,
4 quai Antoine 1er,
B.P. 445
MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
Fax: + 377 93 10 81 40

URL: <http://www.iho.int>

Identifier: S-123

Maintenance: Amendments to this specification will be produced on a needs basis. For reporting issues with this specification which need correction, use the contact information.

4.3 Product Specification Maintenance

4.3.1 Introduction

Changes to S-123 will be released by the IHO as a new edition, a revision, or as a document that includes clarification. These are described below.

4.3.2 New Edition

New Editions 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-123.

4.3.3 Revisions

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

4.3.4 Clarification

Clarifications are non-substantive changes. Typically, clarifications: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; insert improved graphics in spelling, punctuation and grammar. Clarification must not cause any substantive semantic changes.

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

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

4.3.5 Version Numbers

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

New Editions denoted as **n.0.0**

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

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

4.4 Specification Scope

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

Scope ID: Radio Services datasets.

Hierarchical level: MD_ScopeCode - 005

Hierarchical level name: dataset.

| | |
|---------------------------|--|
| Level description: | information applies to the dataset |
| Extent: | EX_Extent.description: Global coverage of maritime areas |

5 Data product identification

This section describes how to identify data sets that conform to the specification. A dataset that conforms to this Product Specification may be identified by its discovery metadata as defined in clause 12 of this specification. The information identifying the data product may include the following items from S-100 3.0.0 clause 11-6 (adapted from ISO 19115).

| | |
|------------------------------|---|
| title | Marine Radio Services |
| abstract | Radio Services dataset is a vector dataset containing all maritime navigationally relevant information regarding the radio services within a defined geographical area. |
| acronym | MRS |
| content | Maritime Radio Services information, such as types of radio services, characteristics of the radio services, any restrictions that apply, coverage areas and utilization procedures that apply. |
| geographicDescription | EX_GeographicDescription: E.g., official name of region |
| spatialResolution | MD_Resolution>equivalentScale.denominator (integer) or MD_Resolution>levelOfDetail (CharacterString). E.g.: "All scales" |
| purpose | Describing radio services in the maritime domain for utilization in ECDIS, and to allow the producer to exchange radio services information with interested stakeholders. |
| language | EN Additional values if any use CharacterString values from ISO 639-2 |

6 Data Content and Structure

6.1 Introduction

The S-123 product is based on the S-100 General Feature Model (GFM), and is a feature-based vector product. Figure 1 shows how the S-123 application schema is realized from the S-100 GFM. All S-123 features and information classes are derived from one of the abstract classes **FeatureType** and **InformationType** defined in the S-123 application schema, which realize the GFM meta-classes **S100_GF_FeatureType** and **S100_GF_InformationType** respectively.

Radio services features are encoded as vector entities which conform to S-100 geometry configuration level 3b (S-100 section 7-5.3.5). S-123 further constrains Level 3a with the following:

- Coincident linear geometry must be avoided when there is a dependency between features.

- The interpolation of arc by center point and circle by center point curve segments must be circular arcs with center and radius, as described in S-100 §§ 7-4.2.1, 7-4.2.20, and 7-4.2.21.
- The interpolation of other 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. The distance between two consecutive control points must not exceed 0.3 mm at a display scale of 1:10000.

The following exception applies to S-123:

- The use of coordinates is restricted to two dimensions.
- Soundings features which use GM_Point or GM_Multipoint with three dimensional coordinates are not currently included in S-123.

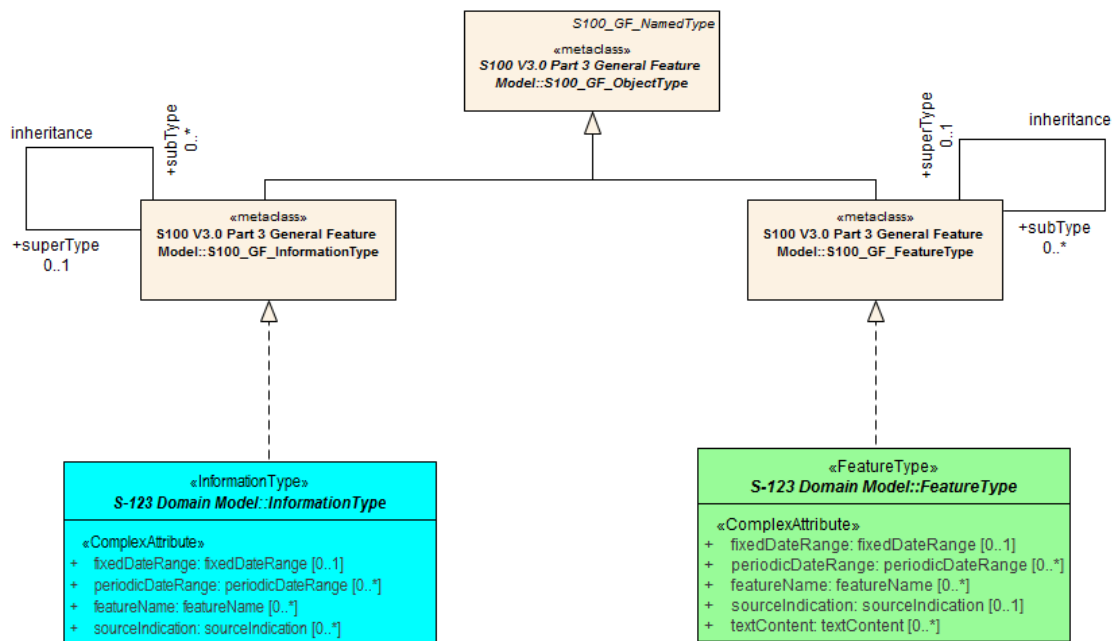


Figure 1. Realizations from the S-100 General Feature Model

This section contains the Application Schema expressed in UML and an associated Feature Catalogue. The Feature Catalogue is included in Annex C, and provides a full description of each feature type including its attributes, attribute values and relationships in the data product. Figure 2 shows an overview of the S-123 application schema.

The classes comprising the S-123 application schema are divided into four packages. The first package, the Domain model, contains the features and information types that model the MRS application domain specifically. Meta-features that provide quality and coverage information are contained within their own package as well as cartographic features, which allow dataset creators to provide cartographically necessary placements where required. A fourth package contains features used for modeling approximate areas. Geographic features in all four packages use the spatial types from S-100 Part 7, which are imported as-is into the S-123 spatial types package and therefore can be used as types for S-123 spatial attributes. The spatial types package also

contains definitions of 'union types' (combinations of the S-100 spatial types). S-100 allows features to have different kinds of geometry, however UML does not allow an attribute of a class to have multiple types. The S-123 application schema models spatial attributes as attributes of feature classes.

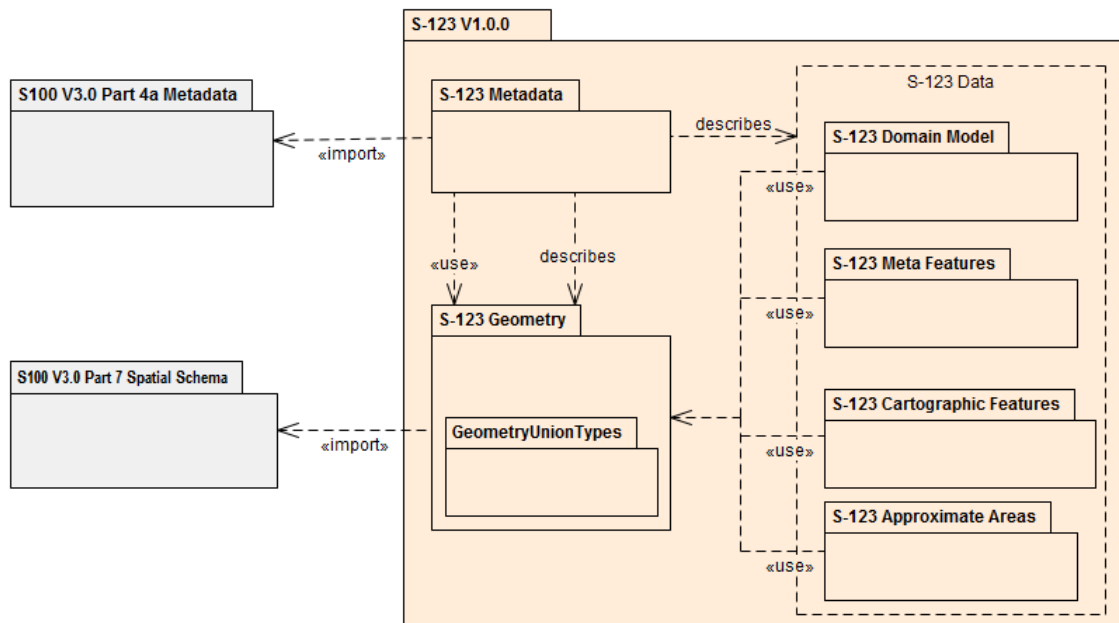


Figure 2. S-123 Data model overview

6.2 Application Schema

The UML models shown below are segments of the overall S-123 application schema, and include overviews of the feature classes, information classes, meta features, spatial types, and the relationships between them.

This section contains a general overview of the classes and relationships in the S-123 application schema. Detailed information about how to use the feature types and information types to encode Radio Services information is provided in the S-123 Data Classification and Encoding Guide (DCEG).

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 color of associations. (Complex diagrams may use different colors 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.

6.2.1 Domain model

The S-123 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 3 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-123 are also derived from the geographic feature root class. Both base classes are abstract classes and do not have direct instances in S-123 data – instead, S-123 feature and information type data objects are instantiations of a non-abstract class derived from one of these base classes.

S-123 meta- and cartographic features are not derived from these base classes – S-123 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.

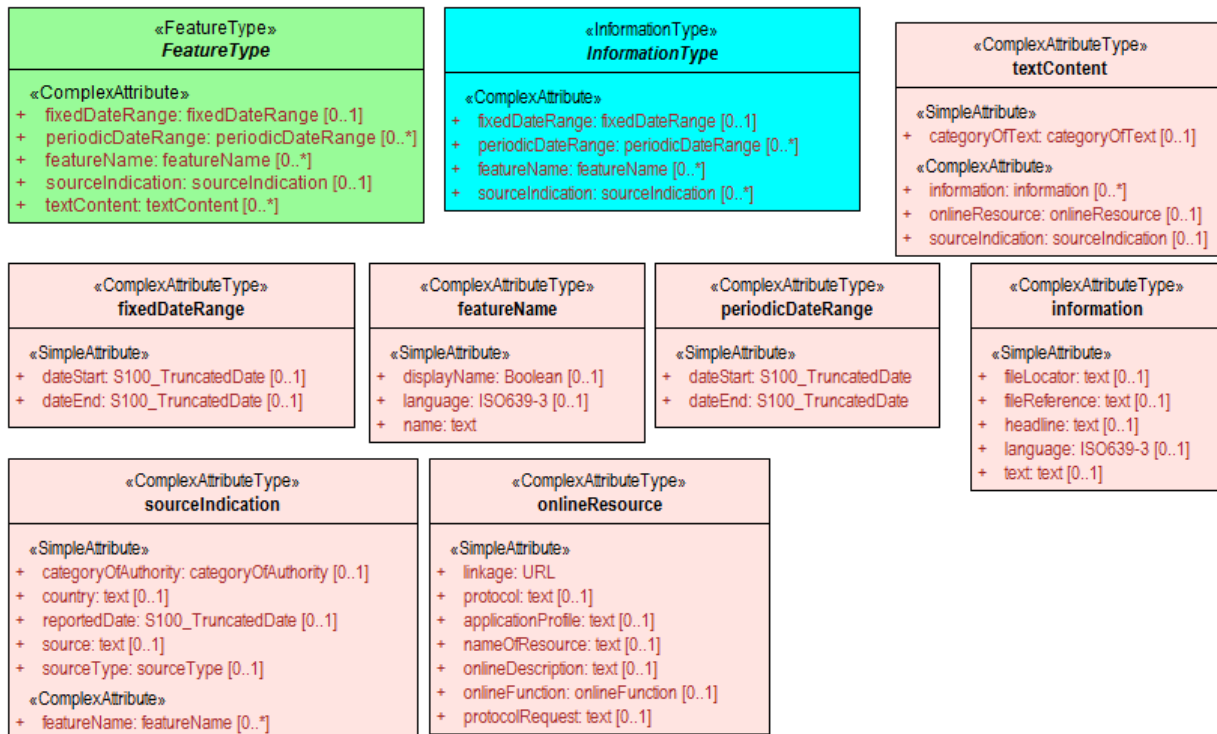


Figure 3. Base classes in S-123 and their attributes

6.2.1.1 Overview of domain features and information types

Radio services data products include marine radio stations and services as well as safety and information broadcasts and radiocommunications. The scope of the S-123 domain model therefore includes NAVTEX and weather or ice forecasts and warnings. NAVAREAs and METAREAs defined by IMO and WMO are also included. There are two broad categories of domain geographic features in the S-123 domain model:

- Features from where (or in which) marine radiocommunications and radio services of one kind or another are directly provided, or where specific equipment requirements apply. This includes marine radio stations and service areas, INMARSAT service areas and GMDSS A1-A4 areas, weather forecast and weather warning areas, and NAVTEX service areas.
- Installations or locations relevant to marine radio services, though their primary function may not be radiocommunications. This includes locations from where radio signals are broadcasted, or places where a radio watch is maintained, for example radio towers and Marine Rescue Coordination Centers. These features are included in the S-123 domain model even if they also serve other functions. However, the focus of S-123 data is on the radiocommunications aspects of such features. Features in this broad category may be encoded without all the attributes and associated features with which they are encoded in other data products. The S-123 feature catalogue and DCEG list the allowed attributes for the S-123 encodings of such features. For example:
 - Marine Rescue Coordination Centers and Rescue Sub-Centers (MRCC and MRSC) are within scope of S-123 and would be included in S-123 datasets, since they maintain radio watches for distress and emergency calls.
 - Landmark features indicating the location of radio masts may be encoded in S-123 datasets, but their color and construction are not included.

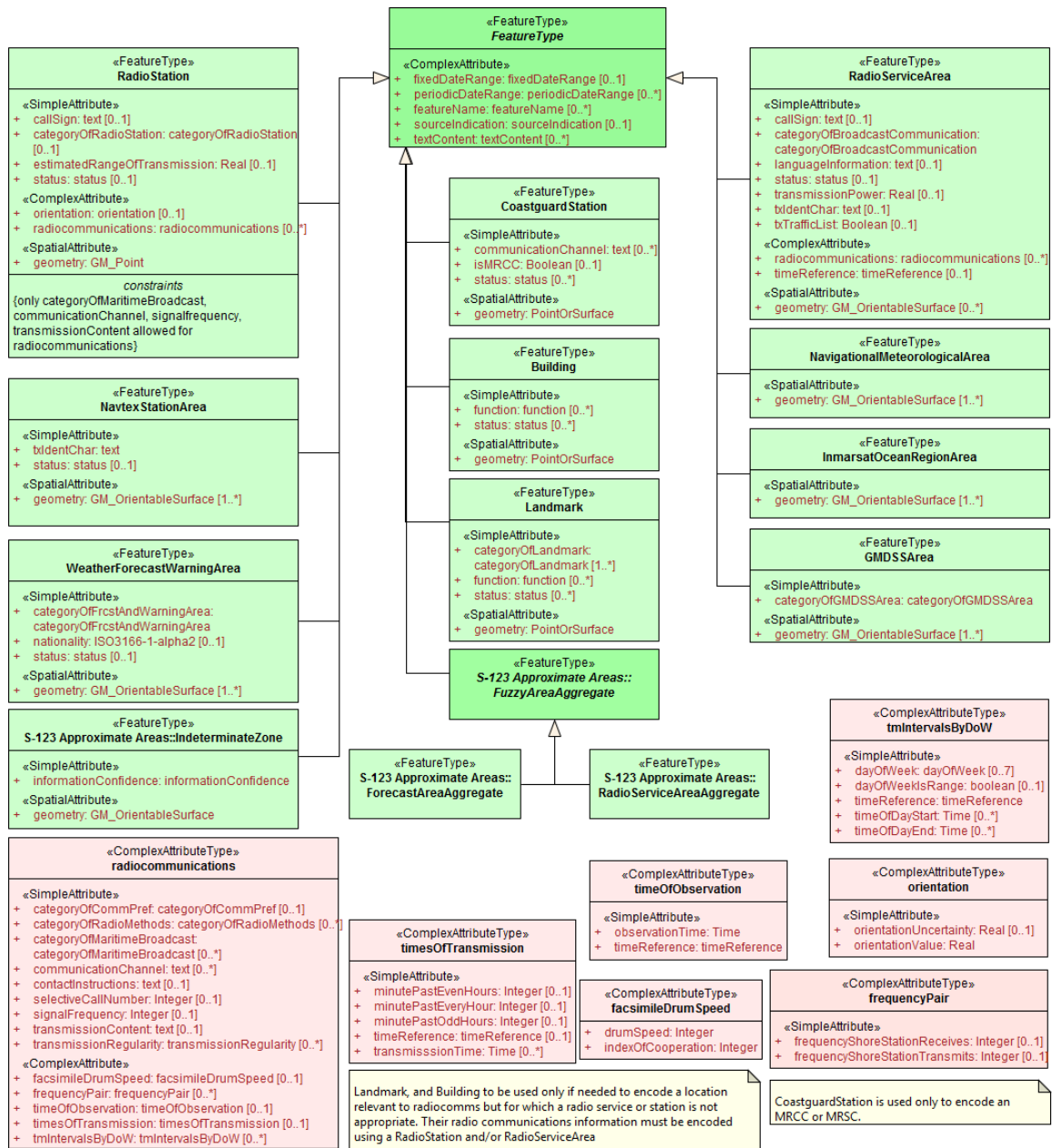


Figure 4. Overview of S-123 Feature Types

The abstract class **FeatureType** is an abstract class from which the geographic feature classes in the application schema are derived. **FeatureType** has attributes for fixed and periodic date ranges indicating the effective dates of the feature, name of the feature, source information, 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-123 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-123 DCEG.

Class **RadioStation** binds the complex attribute **radioCommunications** but is allowed to encode only a limited subset of sub-attributes, as shown in the figure.

Geographic features use spatial types defined in the geometry package for spatial attributes. Datasets comprised of S-123 features are described by metadata as defined in the S-123 metadata package. Metadata uses selected spatial types (specifically, it uses the polygon type to describe the coverage of a dataset).

The S-123 application schema also includes modeling of locations where the availability of a service is intermittent or uncertain, usually dependent on atmospheric and weather conditions. This modeling is currently provided by aggregating areas of different reliabilities using a feature association to an aggregation feature.

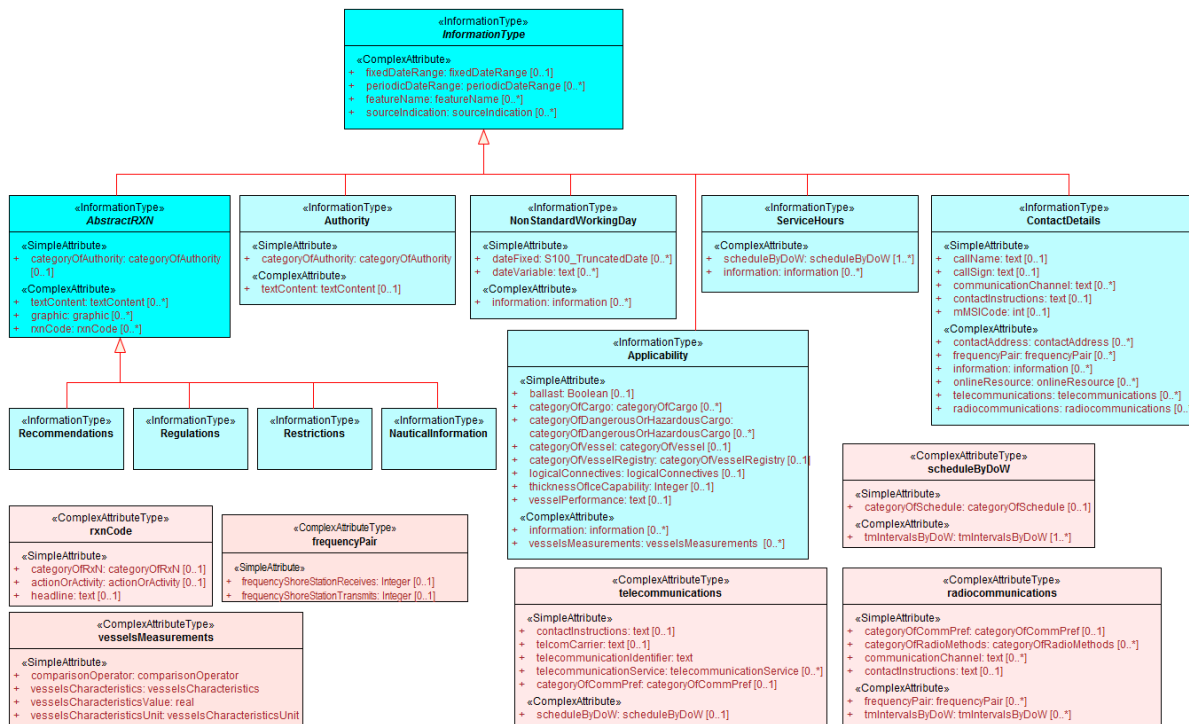


Figure 5. Overview of S-123 Information Types

The abstract class **InformationType** is an abstract class from which the information type classes in the S-123 domain model 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-123 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-123 DCEG.

6.2.1.2 Regulations, information notes, etc.

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 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-123 this may be recommendations for maintenance of listening watches, AMVER reporting, etc., that are either voluntary or have not been issued as formal regulations.
- 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 text information, such as that which derives from textual source material such as national or local laws or official publications. Where specific attributes such as the simple attribute **restriction** are permitted, they must be used. For example, if a geographic feature class has the **restriction** attribute, it should be used instead (explanations, details, paragraphs from regulations, etc., can be encoded in an associated **Regulations**, **NauticalInformation**, etc., object).

The use of these information types to associate regulatory and other information to individual features is described elsewhere in clause 6.2.1.

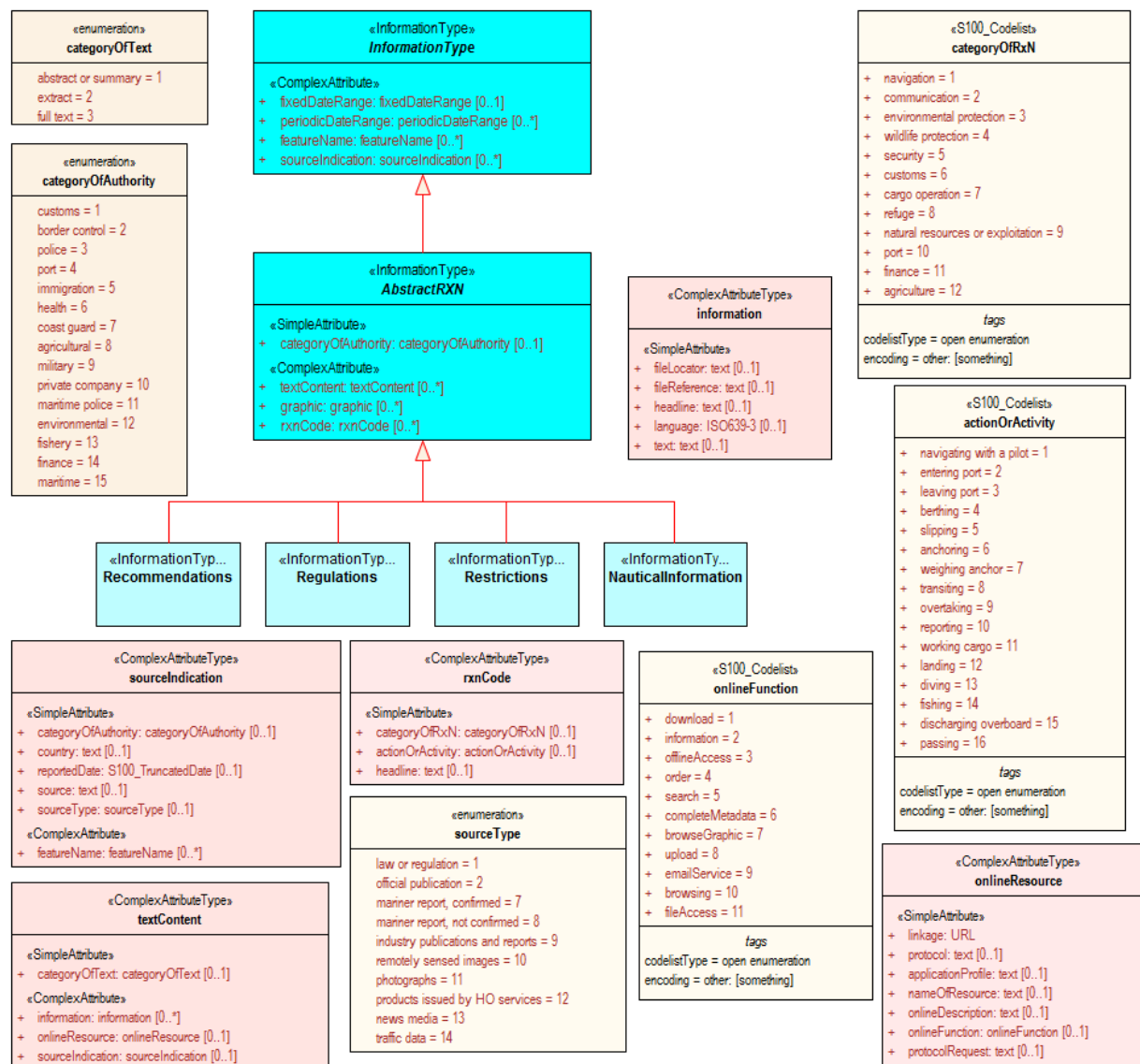


Figure 6. Structure of regulations and note information types

6.2.1.3 Radio stations and services

Marine radio stations and service areas are modeled by the **RadioStation** and **RadioServiceArea** features. MRCCs and MRSCs are modeled by **CoastGuardStation** features (in conformance to S-101 modeling).

A radio station may provide more than one type of service, and the coverage of different services may be different. The S-123 model allows a radio service area to be encoded with or without the station from which the service is provided, and vice versa. If a radio station and its service area(s) are both encoded, the relationship between them is modeled by the *serviceProvisionArea* feature association (see Figure 7).

Within a single service area, different combinations of channels, frequencies, or modes of communication often correspond to different content, transmission or watch schedules. Further, channels and frequencies are often designated as preferred and alternate calling/working

channels. The **radiocommunications** complex attribute allows grouping of channels, frequencies, or transmission/receptions by content, times of operation, preferences, etc.

Additional information about the service operating schedule for the station or service as a whole is modeled by a *locationHours* association between the feature and a **ServiceHours** object. Similarly, contact information (in addition to radio methods) for the operator or responsible authority of the station or service area as a whole is modeled using a *srvControl* association to a **ContactDetails** object.

The **ContactDetails** class contains attributes describing the contact methods and identifiers for various contact methods for the operating or controlling authority, ranging from radiocommunications, to postal addresses. It is linked to the relevant instance of **RadioServiceArea**, **RadioStation**, or **CoastguardStation** by the *srvControl* association. **ContactDetails** may be repeated if an agency or office has more than one call name, call sign, or MMSI code. Other attributes such as communication channel and contact address may be repeated within the same instance, e.g., if there are different postal addresses for different purposes. Clarifying instructions about which address to use when, etc., may be provided in attribute **contactInstructions**. If the clarifying instructions relate to only a particular combination of content, channels, etc., they are encoded in the **contactInstructions** of the appropriate **radiocommunications** complex attribute instead.

If an operating schedule for the station or service area as a whole is to be encoded, it is done using an associated **ServiceHours** class, linked to the service feature by the *locationHours* association. Operating schedules that are specific to particular methods, channels, or sets of frequencies within a single service area are modeled by means of the time intervals attribute (**tmIntervalsByDoW**) of complex attribute **radiocommunications**.

Figure 7 shows the services which may have service times and operator/controller contact details encoded. The detailed models of **ContactInformation** and **ServiceHours** are described later in this section.

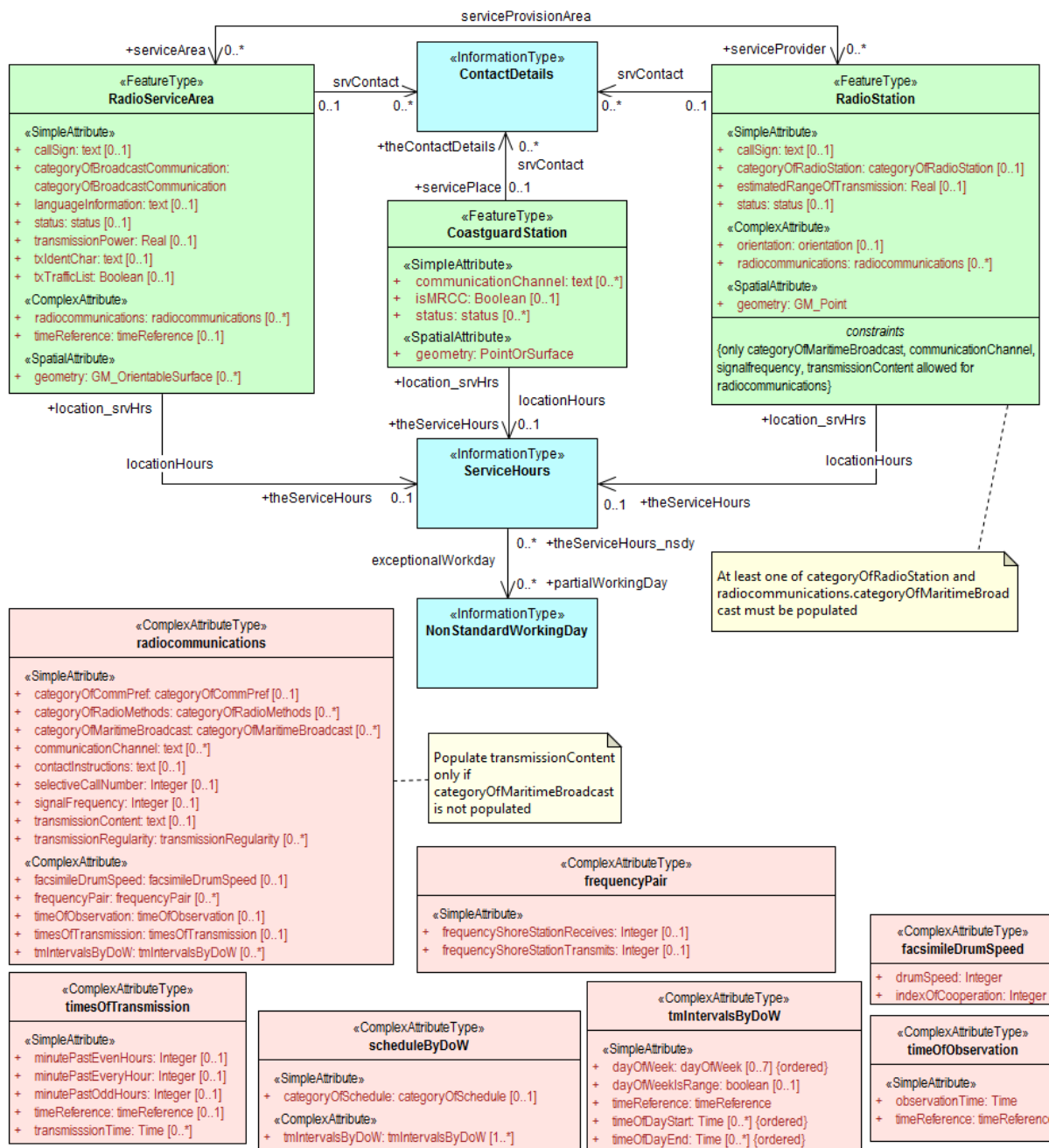


Figure 7. Service operating hours and contact information

Indications about the specific controlling or responsible authority for a specific protected area or traffic control area are provided by means of associations from the service feature to the **Authority** information type. These are shown in a separate diagram since they are common to all service features.

To allow encoding of radio stations pertaining to more specific types of radio services, the *serviceProvisionArea* association is also permitted between more specific service area types and **RadioStation**, as shown in Figure 8.

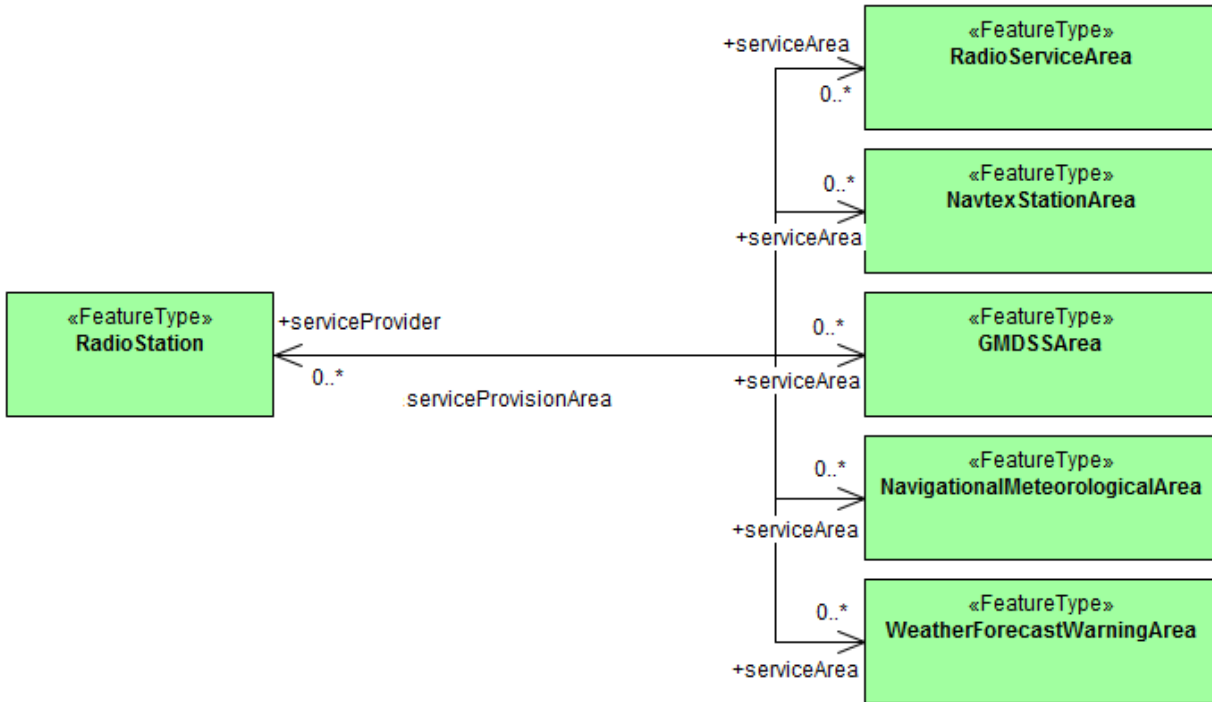


Figure 8. Service areas and provider(s)

6.2.1.4 Contact information for services and organizations

The detailed model of contact information is shown in Figure 9 below, along with the features and information types with which it can be associated. (The color of links is not significant.)

The **ContactDetails** class uses a condensed form of the complex attribute **radiocommunications** mentioned in the previous section. When used as an attribute of **ContactDetails**, the sub-attributes of **radiocommunications** are restricted to those shown in Figure 9. The complex attribute **telecommunications** is analogous to **radiocommunications**, but describes telephone contact data.

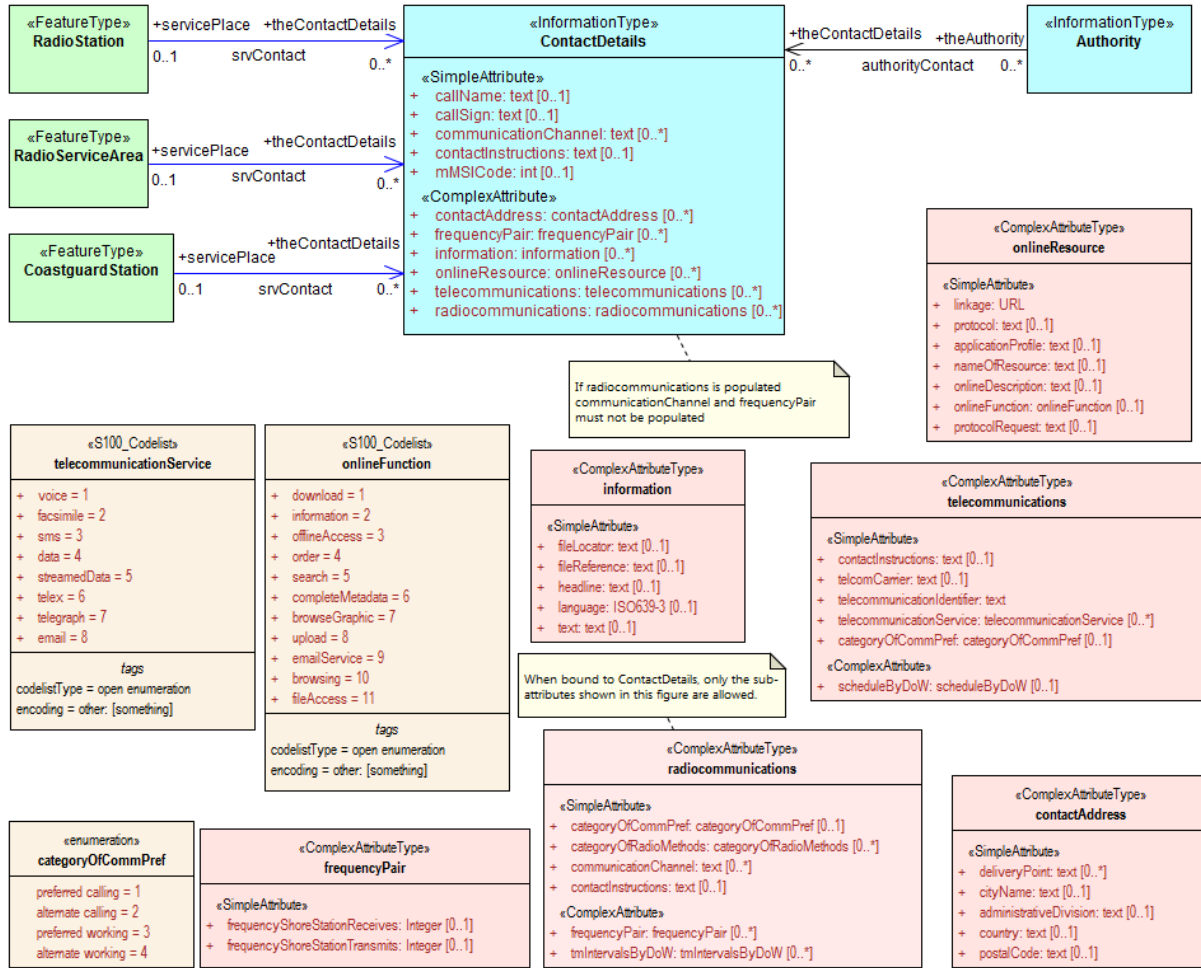


Figure 9. Contact information - detail

6.2.1.5 Daily schedules and business hours

Operating schedules and business hours of organizations are modeled by associating the **ServiceHours** class to an **Authority**. The **ServiceHours** class is a container for the complex attribute describing daily schedules for different weekdays (**scheduleByDoW**). 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 modeled by a **NonStandardWorkingDay** class with attributes allowing indication of the dates or days which are holidays or exceptions.

Working times and schedules for service features are modeled 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 offered in a **RadioServiceArea**).

The model for both kinds of schedules is shown in Figure 10. (The color of links is not significant.)

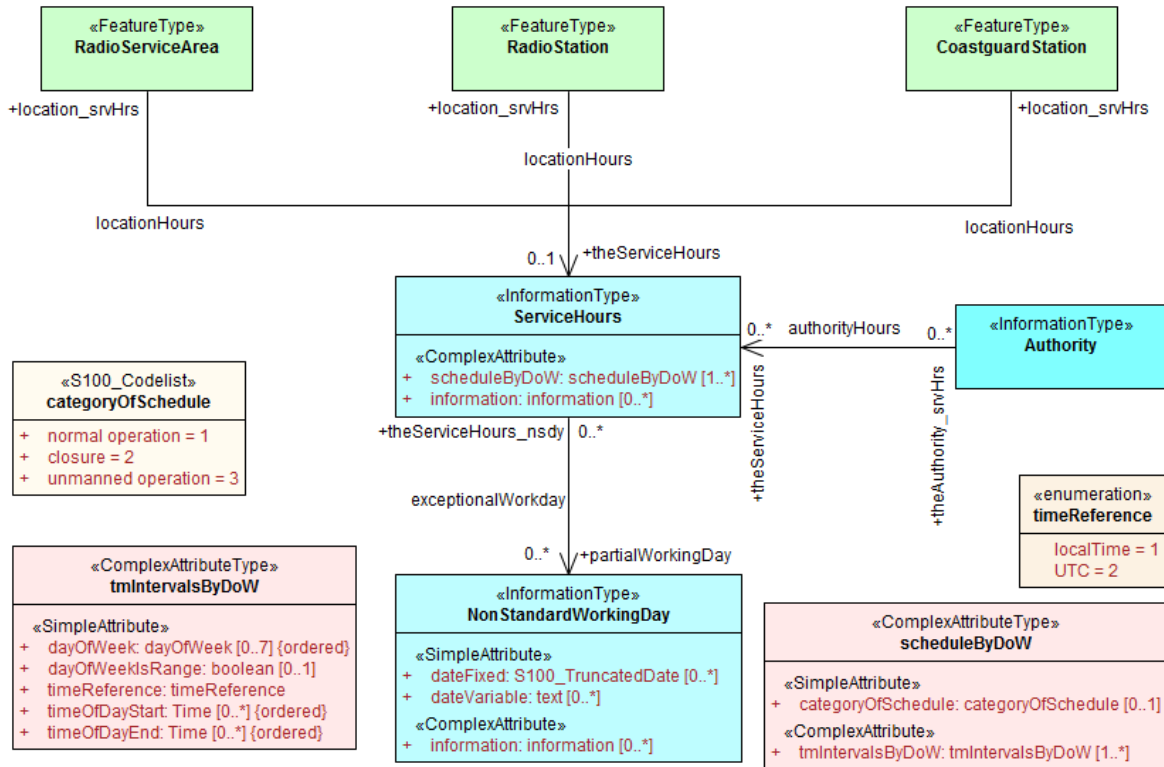


Figure 10. Working times and schedules

6.2.1.6 Controlling or operating organisations

All the service features in S-123 can be associated to a controlling or operating organization using the **controlAuthority** association. The authority should be encoded only if its presence in the dataset conveys information that is useful to the end user.

Since **Authority** has an information association, it is in principle possible to link a **RadioStation** (for example) to both an **Authority** and **ContactDetails** as well as linking the **Authority** to the same **ContactDetails**. Such linking is permissible but will generally be redundant and should, if possible, be avoided as unnecessary duplication. There may be situations where contact details for an operating authority are different from contact details for the radio station it operates, but given that the **RadioServiceArea**, **CoastguardStation**, and **RadioStation** can be associated directly to **ContactDetails** and **ServiceHours**, and assuming the reason is only to provide contact or operating hours data, such direct links should be preferred over adding an **Authority** object.

Associations between service features and **Authority**, **ContactDetails**, and **ServiceHours** information types are shown in Figure 11. **Authority-ContactDetails/ServiceHours** associations are omitted to reduce clutter. (Associations colors are used only to distinguish crossing lines and to indicate commonalities.)

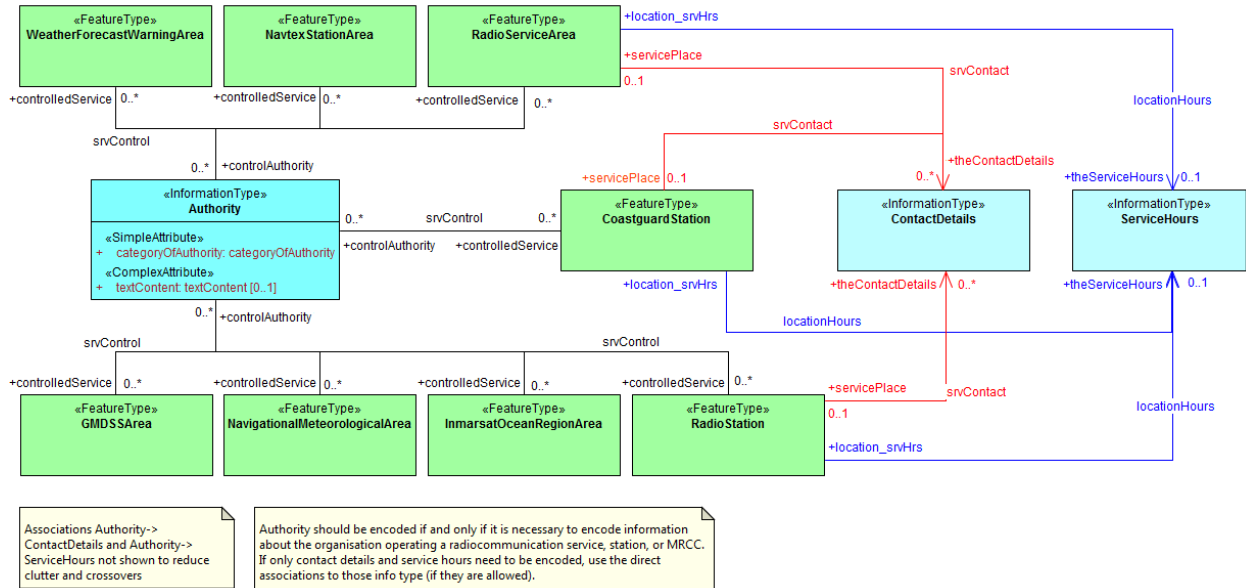


Figure 11. Controlling or operating authorities for service features

6.2.1.7 Regulations applying in specific geographic features

The **associatedRxN** association between a feature type and a **Regulations, Restrictions, Recommendations**, or **NauticalInformation** object 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.).

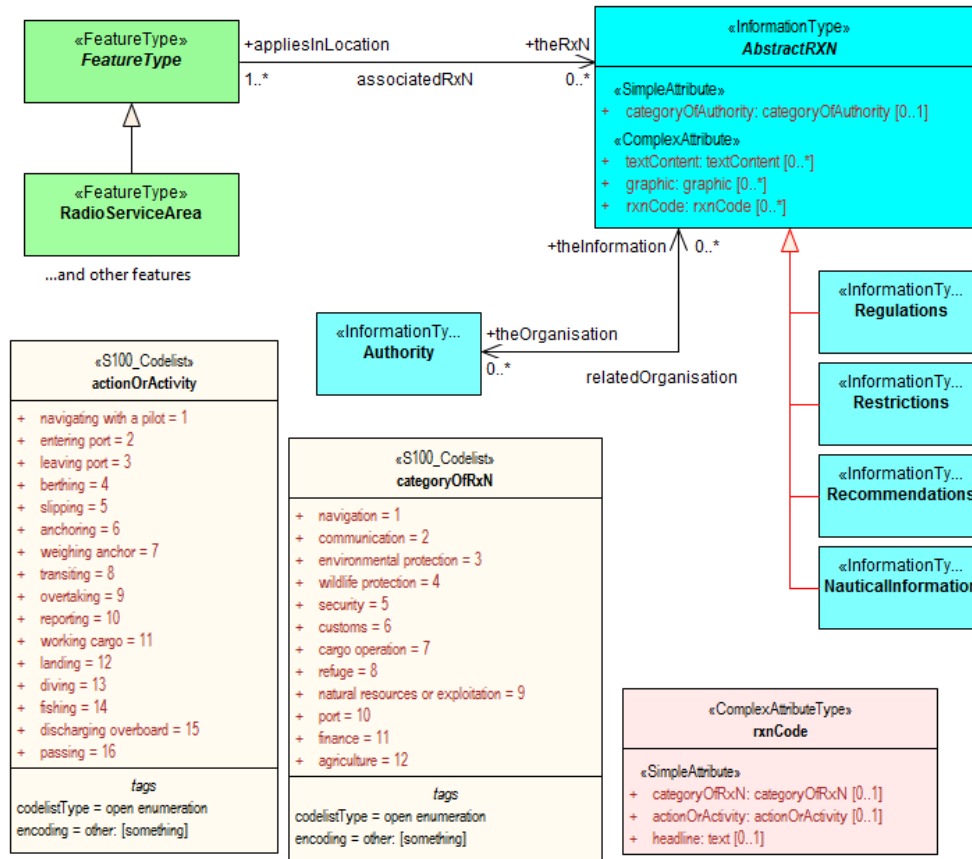


Figure 12. Regulations, etc., relevant to specific features

6.2.1.8 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 modeled 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 modeled 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 modeled using the attributes of **Applicability** can be described in plain text in its **information** attribute.

Conditions relating to vessel dimensions are modeled by the complex attribute **vesselsMeasurements**, 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):

| | Condition 1 | Condition 2 | Condition 3 |
|----------------------------|----------------|----------------|--------------|
| vesselsCharacteristics | length overall | length overall | breadth |
| vesselsCharacteristicsUnit | metre | metre | metre |
| comparisonOperator | greater than | less than | greater than |

| | | | |
|-----------------------------|----|----|----|
| vesselsCharacteristicsValue | 50 | 90 | 20 |
|-----------------------------|----|----|----|

Table 6.1 - Conditions relating to vessel dimensions

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 modeling 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.

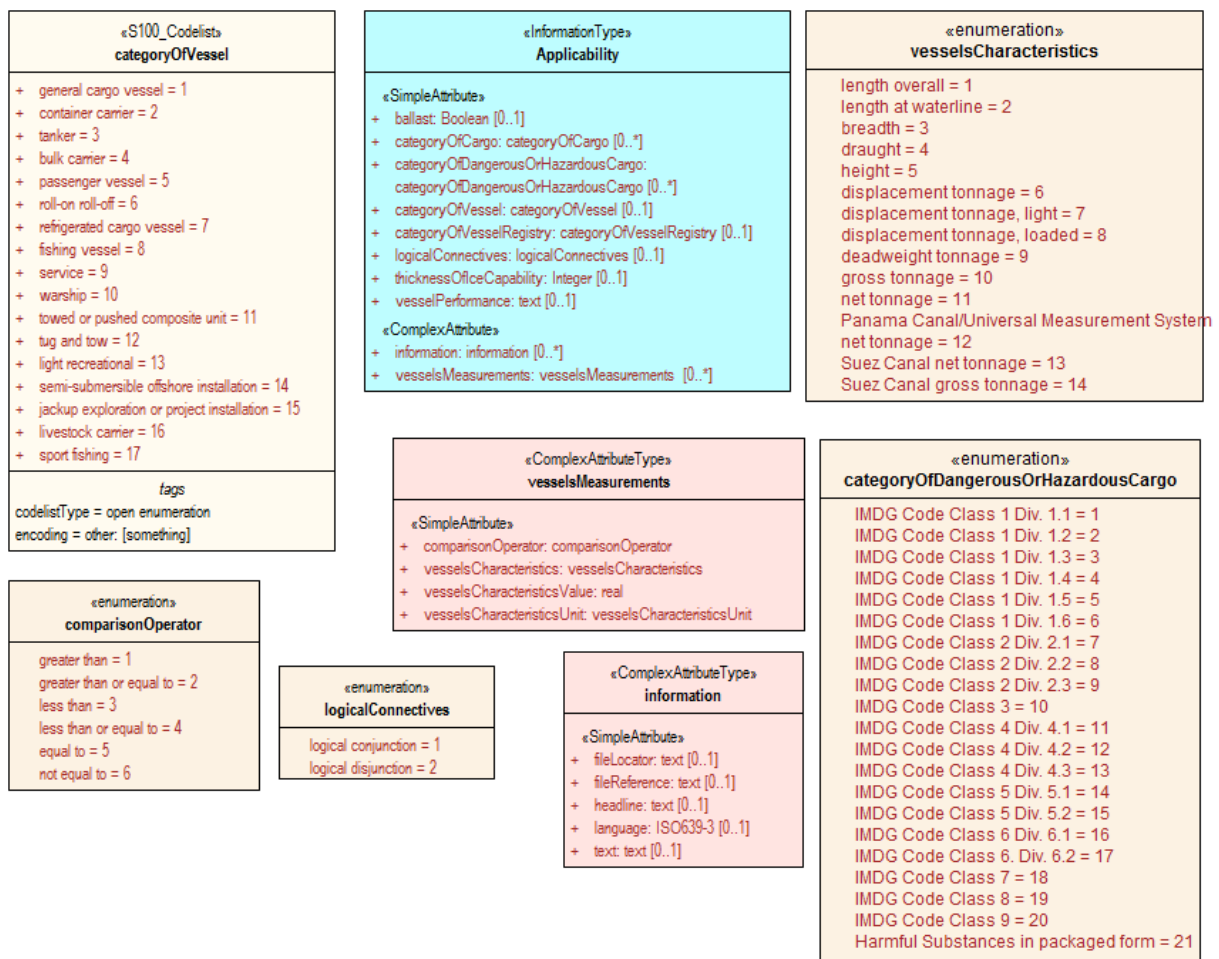


Figure 13. Vessel subsets characterized by cargo and dimensions

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.

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

- A specified set of vessels is COVERED by a regulation and another set of vessels is EXEMPT from the regulation.
- Vessels with specified cargo & dimensions MUST use a specified pilot boarding place, vessels of smaller dimensions are RECOMMENDED to use the boarding place, and warships are EXEMPT from using the pilot boarding place.

“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.

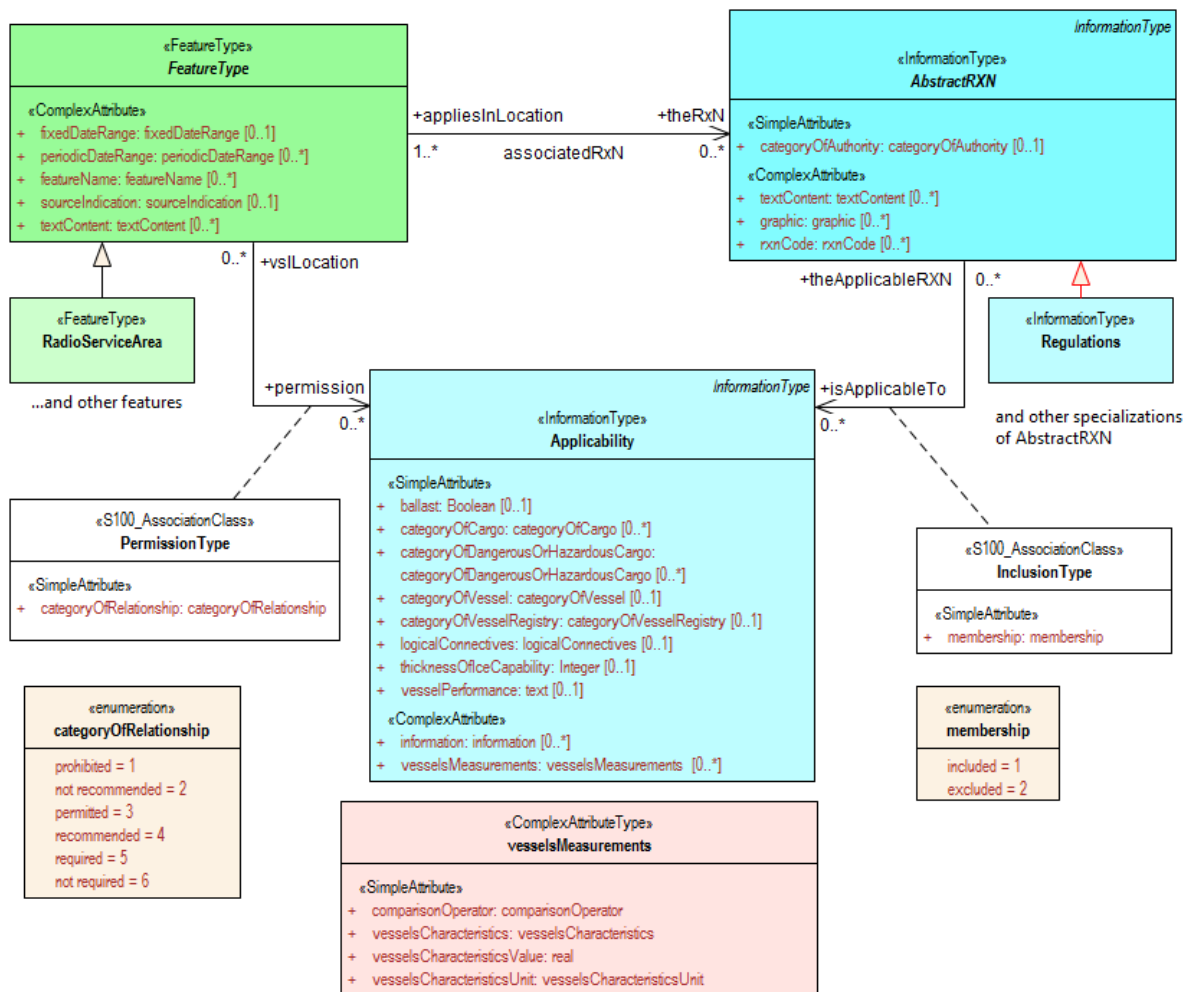


Figure 14. Applicability of reporting requirements, rules, etc. to vessel categories

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:

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

And:-

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

6.2.1.9 Generic fuzzy area model

Fuzzy areas are areas where the applicability of information described by a specific feature is uncertain, intermittent, or possible. The basic information concept can be the availability of a service, the existence of a natural phenomenon, etc. An example is an area where radio reception cannot be asserted with sufficiently high confidence to encode it as a definitely within the service area, but reception is sometimes or often possible under good conditions. Associating uncertainty values to boundary points is not sufficient for this concept.

The basic modeling of fuzzy areas consists of a generic feature type that allows cartographers to demarcate areas where the cartographer does not have complete confidence in the existence of the concept described by an associated geographic feature. The level of confidence is described by a limited set of ranked values that correspond roughly to the probability or likelihood that the service will be available, or that the phenomenon will occur. The basic principle of modeling fuzzy or approximate areas is depicted in Figure 15.

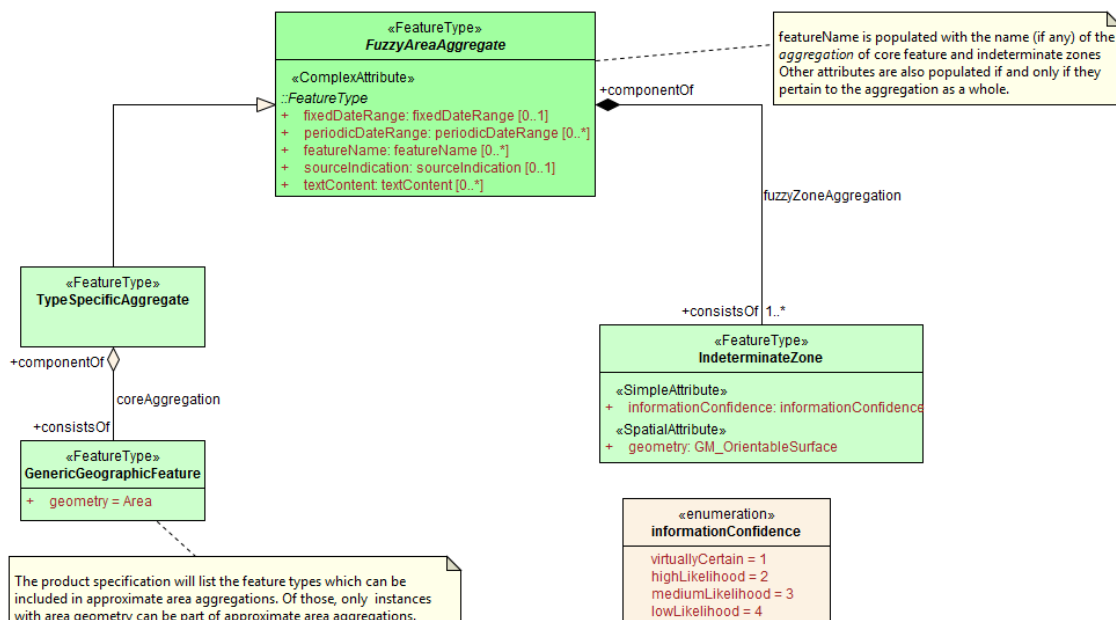


Figure 15. Basic model of fuzzy or approximate areas

Areas of uncertainty are modeled by an **IndeterminateZone** geographic feature. A ‘fuzzy area’ will therefore consist of a ‘core’ feature of the appropriate geographic feature type and the appropriate geometry (e.g., a **RadioServiceArea** area feature) and one or more ‘fuzzy’ Indeterminate Zone features (with surface geometry). Each **IndeterminateZone** feature has a thematic attribute expressing the level of confidence that the service described by the core feature will be available (or the natural phenomenon will occur) in the region demarcated by its spatial primitive(s). To provide for properties of the collection of core and fuzzy features (e.g., a collective name for the totality of core and fuzzy areas), an abstract aggregation feature is defined, associated to the indeterminate zone features. This abstract aggregation feature is subclassed by type-specific aggregation features corresponding to the geographic feature types which can be fuzzy. Type-specific attributes for aggregates can be added to these features.

6.2.1.10 Fuzzy areas in the S-123 application schema

S-123 modeling of fuzzy areas is used for radio service area and weather forecast and warning area features. S-123 uses the generic model of fuzzy areas described in the previous clause and subclasses the abstract **FuzzyAreaAggregate** class into two aggregate classes. **RadioServiceAreaAggregate** and **ForecastAreaAggregate** respectively.

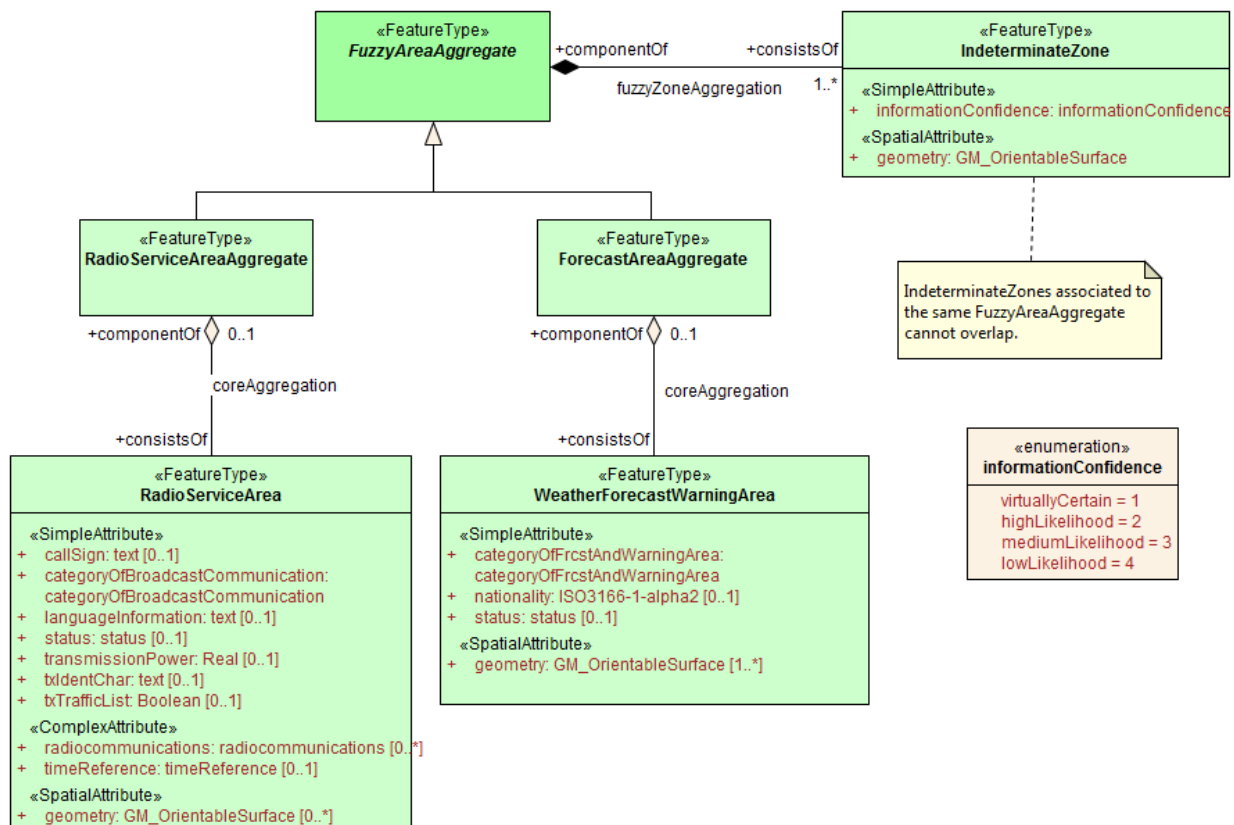


Figure 16. Fuzzy areas in S-123

6.2.1.11 S-123 Enumerations and codelists

For completeness, the enumerations and codelists in the S-123 domain are provided in Figures 17–20. They are divided into multiple figures for convenience.

| | | |
|--|--|--|
| «S100_Codelists» actionOrActivity <ul style="list-style-type: none"> + navigating with a pilot = 1 + entering port = 2 + leaving port = 3 + berthing = 4 + slipping = 5 + anchoring = 6 + weighing anchor = 7 + transiting = 8 + overtaking = 9 + reporting = 10 + working cargo = 11 + landing = 12 + diving = 13 + fishing = 14 + discharging overboard = 15 + passing = 16 tags codelistType = open enumeration encoding = other: [something] | «S100_Codelists» categoryOfSchedule <ul style="list-style-type: none"> + normal operation = 1 + closure = 2 + unmanned operation = 3 tags codelistType = open enumeration encoding = other: [something] | «S100_Codelists» onlineFunction <ul style="list-style-type: none"> + download = 1 + information = 2 + offlineAccess = 3 + order = 4 + search = 5 + completeMetadata = 6 + browseGraphic = 7 + upload = 8 + emailService = 9 + browsing = 10 + fileAccess = 11 tags codelistType = open enumeration encoding = other: [something] |
| «S100_Codelists» telecommunicationService <ul style="list-style-type: none"> + voice = 1 + facsimile = 2 + sms = 3 + data = 4 + streamedData = 5 + telex = 6 + telegraph = 7 + email = 8 tags codelistType = open enumeration encoding = other: [something] | «S100_Codelists» categoryOfVessel <ul style="list-style-type: none"> + general cargo vessel = 1 + container carrier = 2 + tanker = 3 + bulk carrier = 4 + passenger vessel = 5 + roll-on roll-off = 6 + refrigerated cargo vessel = 7 + fishing vessel = 8 + service = 9 + warship = 10 + towed or pushed composite unit = 11 + tug and tow = 12 + light recreational = 13 + semi-submersible offshore installation = 14 + jackup exploration or project installation = 15 + livestock carrier = 16 + sport fishing = 17 tags codelistType = open enumeration encoding = other: [something] | «S100_Codelists» categoryOfRxN <ul style="list-style-type: none"> + navigation = 1 + communication = 2 + environmental protection = 3 + wildlife protection = 4 + security = 5 + customs = 6 + cargo operation = 7 + refuge = 8 + natural resources or exploitation = 9 + port = 10 + finance = 11 + agriculture = 12 tags codelistType = open enumeration encoding = other: [something] |

Figure 17. Codelists

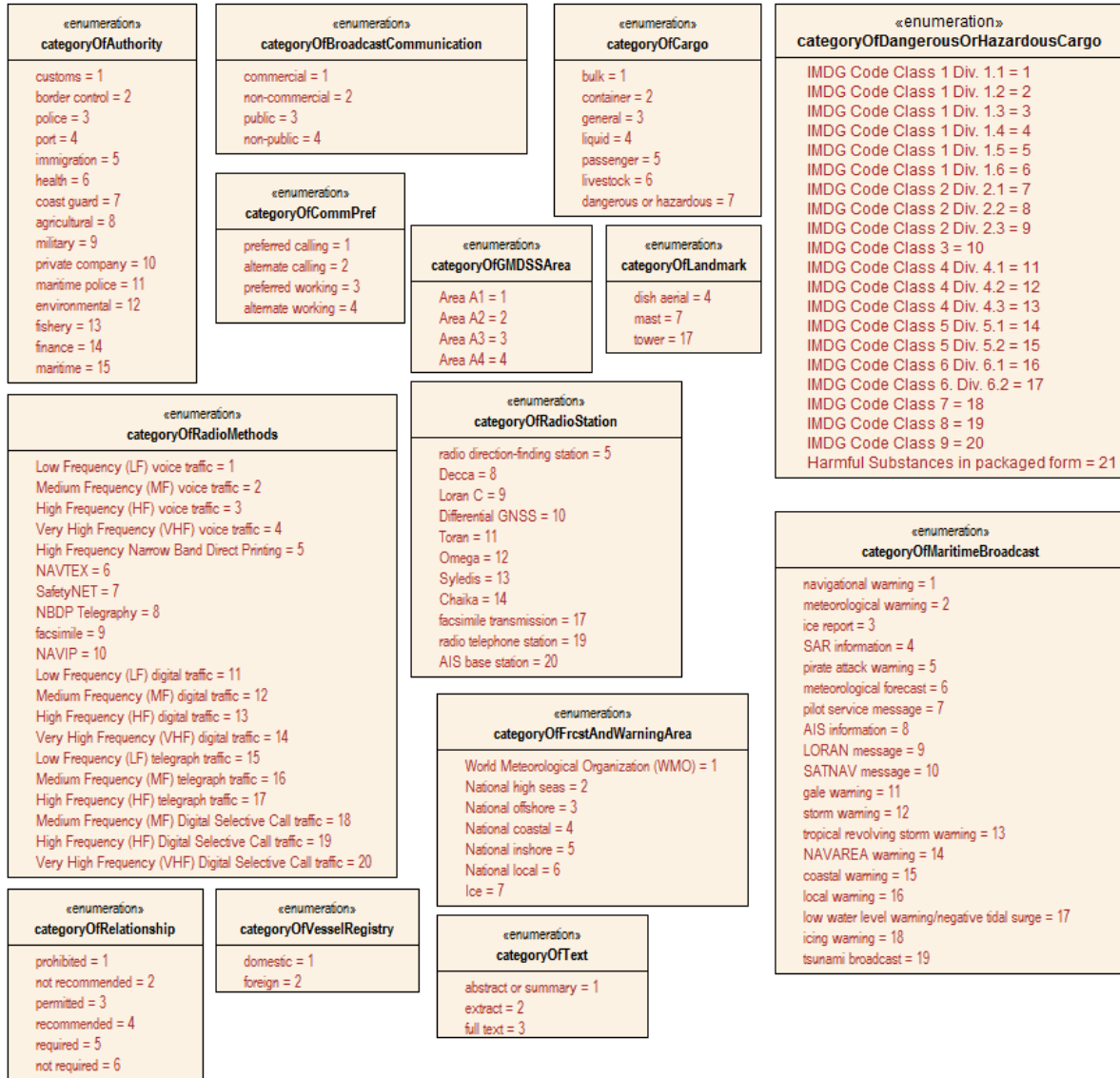


Figure 18. Category enumerations

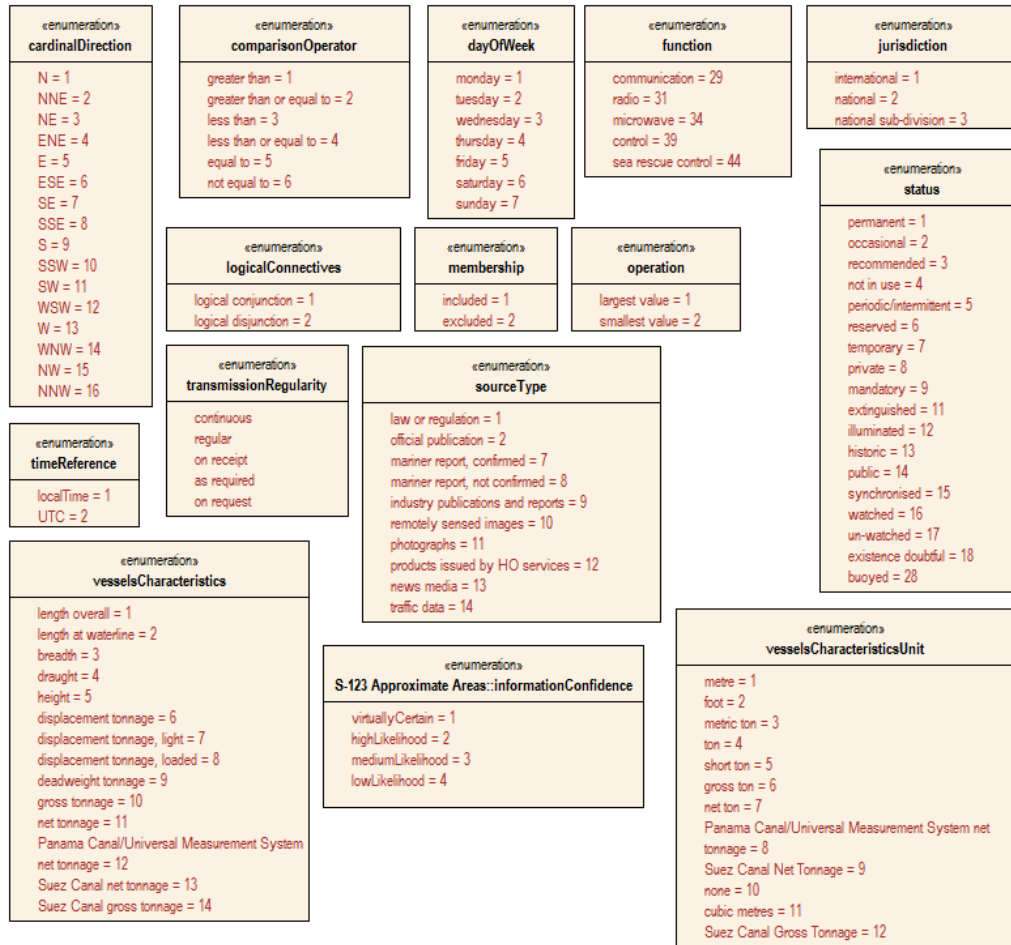


Figure 19. Other enumerations and codelists

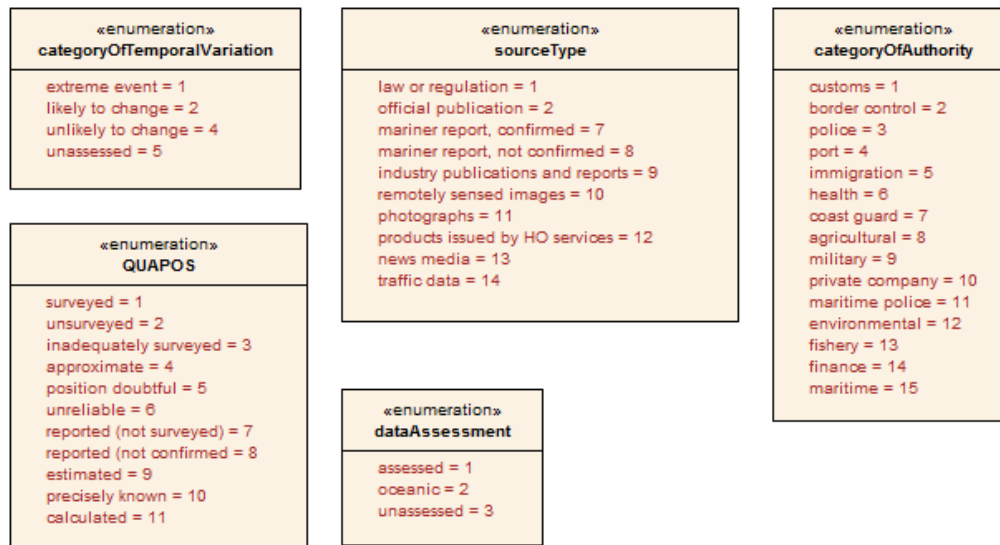


Figure 20. Enumerations for meta-features

6.2.1.12 Uncategorized additional 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 specific 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.

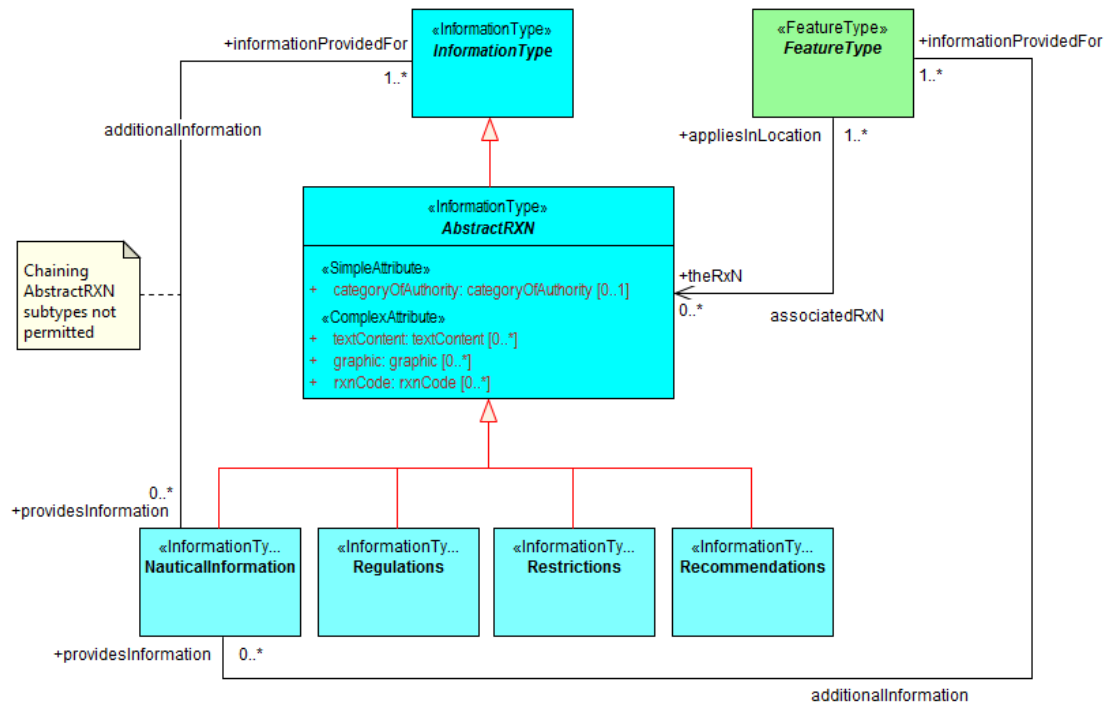


Figure 21. Attachment of uncategorizable information to any feature or information type

The **additionalInformation** association must not be used to chain **NauticalInformation**, **Regulations**, **Restrictions**, or **Recommendations** objects, whether they are of the same class or different classes.

6.2.2 Meta features

S-123 has two meta feature classes. The first one is **QualityOfNonbathymetricData** and is derived from **QualityOfTemporalVariation**, which in turn is derived from **DataQuality**. The second is **DataCoverage**.

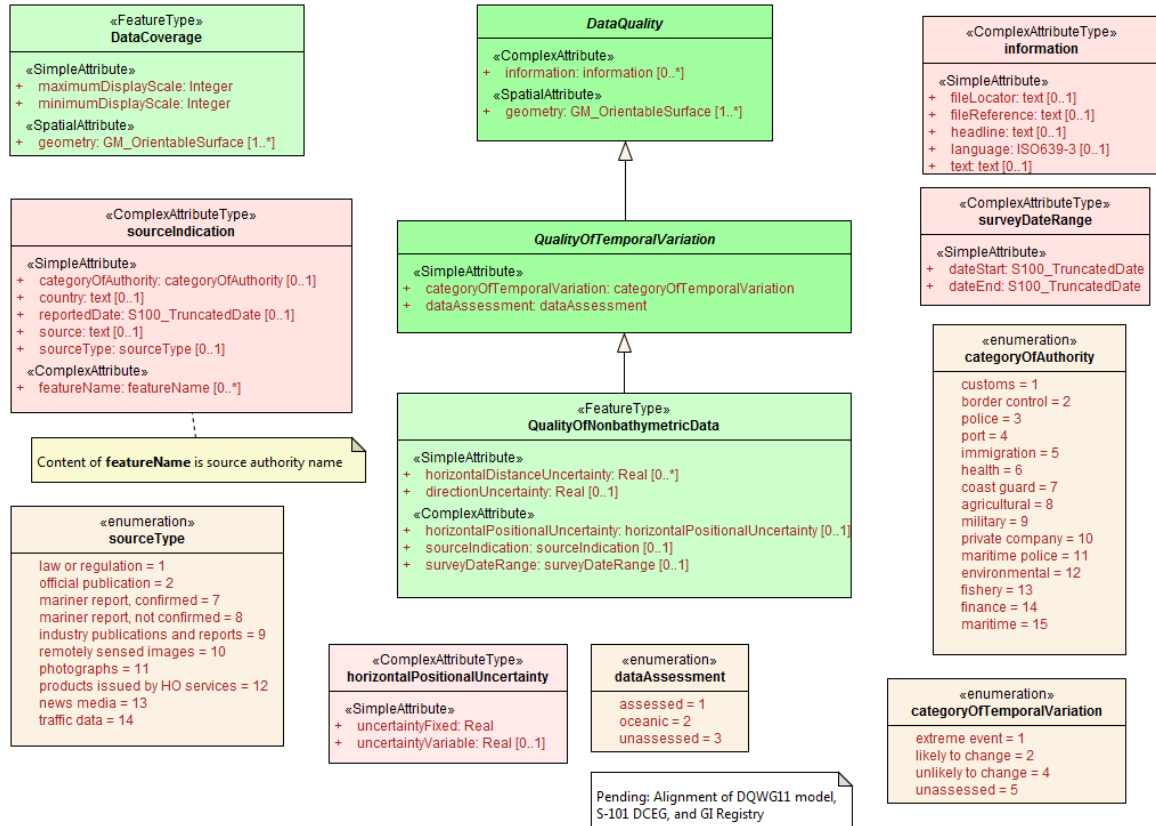


Figure 22. Overview of Meta feature classes and enumerations

6.2.3 Spatial quality information type

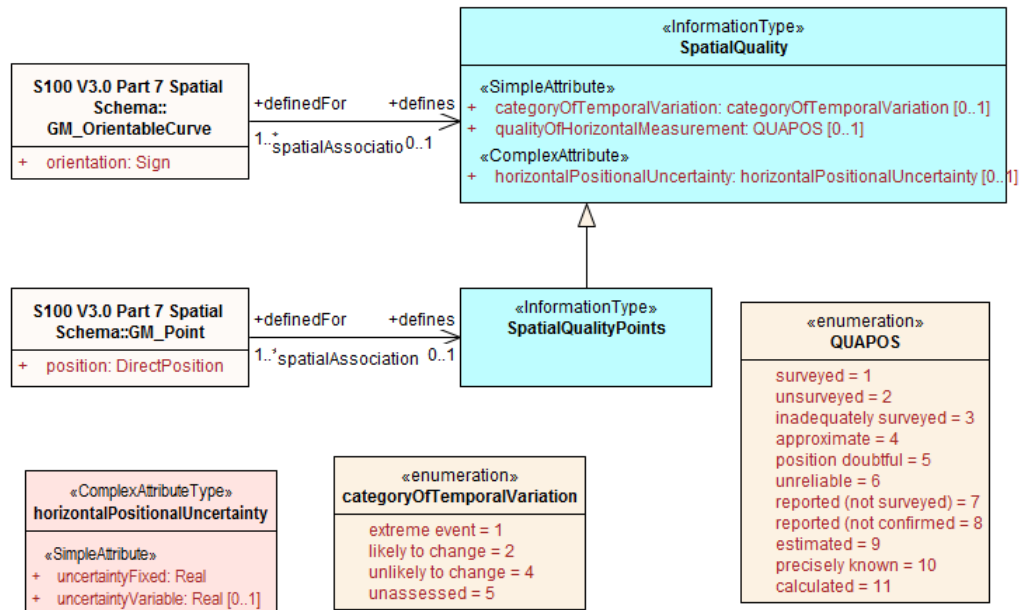


Figure 23. Spatial quality

S-123 spatial quality is composed of two information types, namely **SpatialQuality** and **SpatialQualityPoint**, which is derived of the first. As the name indicates, the latter is for spatial points, while **SpatialQuality** is for curves. The attributes are for temporal quality and qualitative and quantitative horizontal quality.

6.2.4 Cartographic features

S-123 utilizes a cartographic feature called **TextPlacement** that is used in association with the **featureName** attribute to optimise text positioning. This feature can be associated to any geographic feature and gives the location of a text string relative to the location of the feature.

7 Feature Catalogue

7.1 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-123 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 website (<http://www.iho.int/>). Simple attributes used in this specification are listed in Table 7.1 below.

| | |
|------------------------|--|
| Name: | Radio Services Feature Catalogue |
| Scope: | Ocean, Coastal, Ports, Harbors and Inland waters |
| Version Number: | 1.0.0 |
| Version Date: | 2017-08-31 |
| Producer: | International Hydrographic Organization Secretariat, 4 quai Antoine 1er, B.P. 445 MC 98011 MONACO CEDEX Telephone: +377 93 10 81 00 Telefax: + 377 93 10 81 40 URL http://www.iho.int |

Language: English

7.2 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.

7.2.1 Geographic

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

7.2.2 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.

7.2.3 Feature Relationship

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

7.2.4 Information Types

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

7.2.5 Attributes

S-123 defines attributes as either simple or complex.

7.2.5.1 Simple Attributes

S-123 uses ten types of simple attributes; they are listed in the following table:

| Type | Definition |
|-----------------|---|
| Enumeration | A fixed list of valid identifiers of named literal values |
| Boolean | A value representing binary logic. The value can be either True or False. The default state for Boolean type attributes (i.e. where the attribute is not populated for the feature) is False. |
| Real | A signed Real (floating point) number consisting of a mantissa and an exponent |
| Integer | A signed integer number. The representation of an integer is encapsulation and usage dependent. |
| CharacterString | An arbitrary-length sequence of characters including accents and special characters from a repertoire of one of the adopted character sets |
| Date | A date provides values for year, month and day according to the Gregorian Calendar. Character encoding of a date is a string which must follow the calendar date format (complete representation, basic format) for date specified by ISO 8601:1988. EXAMPLE 19980918 (YYYY-MM-DD) |
| Time | A time is given by an hour, minute and second. Character encoding of a time is a string that follows the local time (complete representation, basic format) format defined in ISO 8601:1988. EXAMPLE 183059 or 183059+0100 or 183059Z |
| Date and Time | A DateTime is a combination of a date and a time type. Character encoding of a DateTime shall follow ISO 8601:1988 EXAMPLE 19850412T101530 |
| 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. |
| Truncated date | One or more components of the Date type are omitted. |

Table 7.1 – Simple feature attributes.

7.2.5.2 Complex Attributes

Complex attributes are aggregations of other attributes that are either simple or complex. The aggregation is defined by means of attribute bindings.

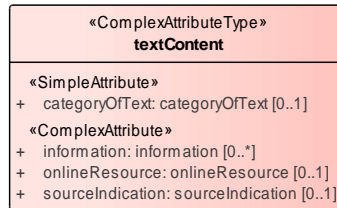


Figure 24. textContent - a complex attribute

7.3 Units of Measure

The following units of measure is used in Marine Radio Services datasets;

- Orientation is given in decimal degrees
- Radio frequency is given in hertz
- Uncertainty is given in metres

7.4 Geometric Representation

Geometric representation is the digital description of the spatial component of an object as described in S-100 and ISO 19107. This product specification uses three types of geometries: GM_Point, GM_OrientableCurve, and GM_OrientableSurface.

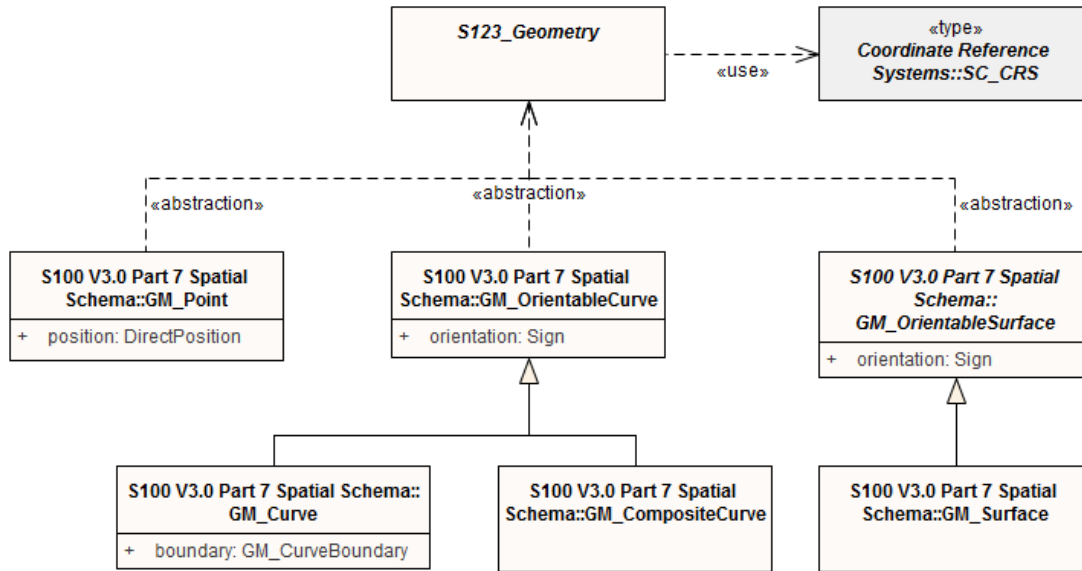


Figure 25. Geometric primitives

8 Coordinate Reference System (CRS)

8.1 Introduction

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.

Horizontal coordinate reference system: WGS 84

Projection: None

Vertical coordinate reference system: Although all coordinates in a dataset must refer to the same horizontal CRS different Vertical Datums can be used for the depth component of a coordinate tuple. Therefore the vertical CRS can be repeated. For each Vertical CRS a unique identifier is defined. Those identifiers will be used to indicate which Vertical CRS is used. Units must be in metres. (From S-101 Draft).

Temporal reference system: Gregorian calendar

Coordinate reference system registry: [EPSG Geodetic Parameter Registry](#)

Date type (according to ISO 19115): 002 - publication

8.2 Horizontal reference system

Positional data is expressed in latitude and longitude geographic coordinates to one of the reference horizontal reference systems defined in the HORDAT attribute. Unless otherwise defined, the World Geodetic System 84 (WGS 84) will be used for MRS data products.

8.3 Projection

Radio Services data products are un-projected.

8.4 Vertical coordinate reference system

Although all coordinates in a dataset must refer to the same horizontal CRS different Vertical Datums can be used for the depth component of a coordinate tuple. Therefore, the Vertical CRS can be repeated. For each Vertical CRS a unique identifier is defined. Those identifiers will be used to indicate which Vertical CRS is used. Units must be in metres.

8.5 Temporal reference system

Time is measured by reference to Calendar dates and Clock time in accordance with ISO 19108:2002 Temporal Schema clause 5.4.4.

8.6 Radio Services data and scale

MRS data must be compiled in the best applicable scale. The use of the data itself is "scale independent". That means that the data can be used at any scale. 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.

9 Data Quality

9.1 Introduction

S-123 products must be tested with the S-123 specific 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 a mix of data format validation checks, conformance to standard checks and logical consistency checks. The checks are listed in Annex E.

10 Data Capture and Classification

S-123 products must be based on data sources released by an appropriate MRS defining authority. Data source must be described in each data product.

The production process used to generate MRS products may be described in the dataset metadata.

| Item Name | Description | Multiplicity | Type |
|-------------------|--|--------------|-----------------------|
| dataSource | Identification of the kinds of data sources usable to product datasets compliant with the considering specification | 0..* | CharacterString |
| productionProcess | Link to a textual description of the production process (including encoding guide) applicable to the datasets compliant with the considering specification | 0..* | CharacterString (URL) |

Table 10-1 Data capture information

10.1 Data Encoding and Product Delivery

10.1.1 Data Encoding

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

10.1.2 Types of Datasets

A dataset is a grouping of features, attributes, geometry and metadata which comprises a specific coverage. The following types of MRS dataset may be produced and contained within an exchange set:

| 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 shall increment up by one from the previous edition. |
| Update dataset | A delta change of the latest edition of a dataset. If there are more than one update dataset, the subsequent update will be a delta of the base dataset + earlier update datasets. |
| Cancellation | Used to cancel dataset. |

Table 10-2 MRS dataset types

10.1.3 Content of Update Datasets

Update datasets can only contain replacements, deletions and additions of whole feature instances or information instances. This means that when a feature or information instance is updated, the new version 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.

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.

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

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.

10.2 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. The encoding is indicated by multiplication factor fields defined in the dataset identification record.

10.2.1 Encoding of coordinates as decimals

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

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

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

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

EXAMPLE 1 A longitude = 42.0000 is converted into $X = \text{longitude} * \text{coordMultFactorX} = 42.0000 * 1 = 42.0000000$.

10.3 Numeric Attribute Encoding

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

10.4 Text Attribute Values

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

10.5 Mandatory Attribute Values

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

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

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

10.6 Unknown Attribute Values

When a mandatory attribute code or tag is present but the attribute value is missing, it means that the producer wishes to indicate that this attribute value is unknown. Missing mandatory attributes must be “nilled” .

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

EXAMPLE A landmark feature has unknown category of landmark (mandatory attribute) and function (optional attribute). The feature could be coded as:

```
<Landmark>
  <categoryOfLandmark xsi:nil="true"/>
  <function>radio</function>
  ... other attributes...
  ... <status> is NOT coded ...
</Landmark>
```

10.7 Structure of dataset files

10.7.1 Sequence of objects

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

Dataset Identification Information

Dataset structure information

Spatial records for by-reference geometries

Point

Multi point

Curve

Composite Curve

Surface

Information objects

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

Meta features

Geo features

10.8 Object identifiers

The “name” of feature records must provide a unique world-wide identifier of feature records.

The “name” of the record is the combination of the subfields **agency**, **featureObjectIdentifier**, and **featureIdentificationSubdivision** elements of the **featureObjectIdentifier** element of the object.

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

10.9 Data coverage

All areas of a dataset must be covered by a dataCoverage meta feature.

An update dataset must not change the limit of a Data Coverage feature for the base dataset. Where the limit of a Data Coverage feature for a base dataset is to be changed, this must be done by issuing a new edition of the dataset.

10.10 Data overlap

S-123 datasets shall not overlap other S-123 datasets.

10.11 Data quality

One or more **QualityOfNonbathymetricData** features shall cover the dataset.

10.12 Data extent

Datasets must not cross the 180° meridian of longitude

11 Data Delivery

11.1 Data Product Delivery Information

This data product specification defines GML as the primary format in which MRS data products are delivered. The delivery format is described by the following items (from ISO 19131:2005): format name, version, specification, language, character set.

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

Table 11-1 Data product delivery

* GML is an XML encoding for the transport and storage of geographic information, including both the geometry and the properties of geographic features, between distributed systems. The XML Schema for the GML application schema is provided in a single schema document S123.xsd (available at the IHO web site or provisionally the IHO S-100 schema distribution site <https://github.com/IHO-S100WG>). Feature instance shall validate against S123.xsd and conform to all other requirements specified in this data product specification including all constraints not captured in the XML Schema document.

11.1.1 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.

11.1.2 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 follow the same rule as above.

11.2 Dataset size

MRS datasets shall not exceed 20MB. Update datasets shall not exceed 500KB.

11.3 Exchange Set

Data which conforms to this product specification must be delivered by means of an exchange set.

An exchange set will consist of one or more MRS datasets. An exchange set may also include one or more support files containing supplementary information encoded in separate files. These are linked to the MRS dataset features, using the attributes described below. Each exchange set will include a single (XML) catalogue file, S-123 exchange set catalogues conform to S-100 3.0.0 Figure 4a-D-2 without modification, containing discovery metadata for each MRS dataset as well as support files. S-123 Exchange set structure conforms to S-100 3.0.0 Figure 4a-D-3 without modification.

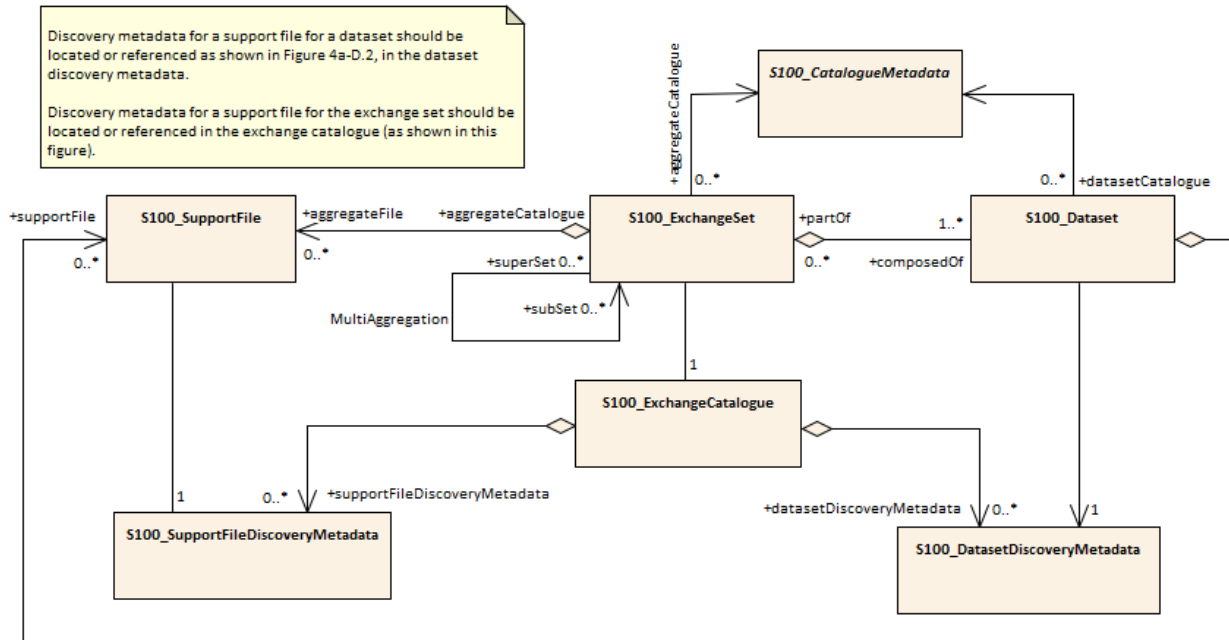


Figure 26 - Exchange set structure

11.4 Support Files

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

- Portable Network Graphics (PNG) [Edition 2.0]
- Scalable Vector Graphics (SVG) [Edition 1.1]
- Tagged Image File Format (TIFF) [Edition 6.0]
- Joint Photographic Experts Group (JPEG) [Edition 1.02]

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

11.5 Support File Naming Convention

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

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

CCNPI123XXXXXXXXX.YYY

The main part forms an identifier where:

- the first two characters identify the issuing agency (according to S-62),
- the third to fifth characters must be NPI to identify that this is nautical publication information,
- the sixth to eighth characters must be 123 to identify that this is S-123 Radio Services information,
- the ninth up to the sixteenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).
- .YYY – support file extension.

11.6 Dataset Naming Convention

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

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

CCNPI123XXXXXXXXX.GML

The main part forms an identifier where:

- the first two characters identify the issuing agency according to S-62.
- the third to fifth characters must be NPI to identify that this is nautical publication information,
- the sixth to eighth characters must be 123 to identify that this is Radio Services information,
- the ninth up to the sixteenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).

11.7 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.

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

CCNPI123XXXXXXXXX_XXX.GML

The main part forms an identifier where:

- the first two characters identify the issuing agency [according to S-62?]
- the third to fifth characters must be NPI to identify that this is nautical publication information,
- the sixth to eighth characters must be 123 to identify that this is Maritime Radio Services information,
- the ninth up to the sixteenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).
- The seventeenth character shall be an underscore
- The eighteenth to twentieth characters shall be numerical (0-9 characters to indicate the place of the update dataset in the update sequence).

11.8 Catalogue File Naming Convention

The exchange catalogue acts as the table of contents for the exchange set. The catalogue file of the exchange set must be named CATALOG.123.XML. No other file in the exchange set may be named CATALOG.123.XML. The content of the exchange catalogue file is described in Section 14.

12 Data Maintenance

12.1 Introduction

Datasets are maintained as needed and must include mechanisms for MRS updating. Data updates will be made by new editions. The maintenance and update frequency of MRS datasets should be defined by the producers (official national authority) implementing this specification.

Data Producers must use applicable sources to maintain and update data and provide a brief description of the sources that were used to produce the dataset in the appropriate metadata field.

The data product shall provide information on how the data is maintained and should describe the principles and criteria applied in maintenance regime. This should specify the expected frequency of updates.

| Item Name | Description | Multiplicity | Type |
|-------------------------------|---|--------------|---------------------------------------|
| maintenanceAndUpdateFrequency | Frequency with which changes and additions are made to the data product (per update scope) | 1..* | MD_MaintenanceInformation (ISO 19115) |
| dataSource | Identification of the kinds of data sources usable to produce datasets | 1..* | LI_Source (ISO 19115) |
| productionProcess | Textual description of the production process applicable to the datasets (per scope or data source) | 1..* | LI_ProcessStep (ISO 19115) |

Table 12-1 Maintenance and update frequency

12.2 Production process for base and update datasets

Data Producers should follow their established production processes for maintaining and updating datasets. Data is produced against the DCEG and checked against the appropriate set of validation rules in Appendix E.

12.3 Dataset updates

The purpose of issue of the dataset is indicated in the “purpose” field of the dataset discovery metadata. In order to terminate a dataset, an update dataset file is created for which the edition number must be set to 0. This convention is only used to cancel a base dataset file.

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 in the correct sequential order from the last update applied to the base dataset file.

12.4 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.

12.5 Feature and portrayal catalogues

For each new version of the S-123 Product Specification a new feature and portrayal catalogue will be released. The system must be able to manage datasets and their catalogues that are created on different versions of the S-123 product specification.

12.6 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.

12.7 Dataset encryption

Details about dataset encryption are still to be determined, and may mirror the method described in S-101.

13 Portrayal

Portrayal is not defined in this version of S-123 Radio Services Product Specifications. Users are free to choose the means and methodology of portrayal as they see best suited for their needs. It should be noted that future versions of S-123 may include a portrayal catalogue, and any implementer should therefore anticipate this, and make sufficient provisions in any system supporting S-123.

14 Metadata

14.1 Introduction

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

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

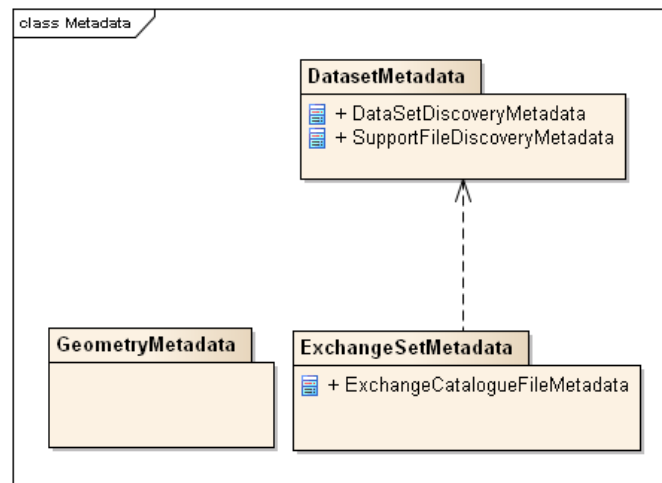


Figure 27 - Metadata packages

Note 1: Types with CI_, EX_, and MD_ prefixes are from packages defined in ISO 19115 and adapted by S-100. Types with S100_ prefix are from packages defined in S-100.

Note 2: When a dataset is terminated, the purpose metadata field is set to 3 (terminated), and the editionNumber metadata field is set to 0. All other metadata fields must be blank.

14.2 Dataset Metadata

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

| Name | Cardinality | Value | Type | Remarks |
|--------------------------------|-------------|-------------------------|---|--|
| S-100_DataSetDiscoveryMetadata | | | | |
| fileName | 1 | | CharacterString | Dataset file name (see 11.6) |
| filePath | 1 | | CharacterString | Full path from the exchange set root directory |
| description | 1 | | CharacterString | |
| dataProtection | 0..1 | {1} or {2} | CharacterString | 1. Encrypted 2. Unencrypted |
| protectionScheme | 0..1 | | CharacterString | For example S-63 |
| digitalSignature | 0..1 | | CharacterString | |
| digitalSignatureReference | 0..1 | | CharacterString | |
| digitalSignatureValue | 0..1 | | CharacterString | |
| copyright | 0..1 | | MD_LegalConstraints - >MD_RestrictionCode <copyright> (ISO 19115) | |
| classification | 0..1 | | Class MD_SecurityConstraints>MD_ClassificationCode (codelist) | 1. unclassified 2. restricted 3. confidential 4. secret 5. top secret |
| purpose | 1 | {1}, {2} | CharacterString | 1. New dataset 2. New edition |
| specificUsage | 1 | | MD_USAGE>specificUsage (character string) MD_USAGE>user ContactInfo (CI_ResponsibleParty) | brief description of the resource and/or resource series usage |
| editionNumber | 1 | {1} | Integer | When a dataset is initially created, the edition number "1" is assigned to it. The edition number is increased by one with each new edition. |
| updateNumber | 1 | | CharacterString | Update number 0 is assigned to a new dataset. |
| updateApplicationDate | 1 | | Date | All updates dated on or before this date must have been applied by the producer. |
| issueDate | 1 | | Date | Date on which the dataset was generated. |
| productSpecification | 1 | S-123 version N.n | CharacterString | This must be encoded as S123.N.n |
| producingAgency | 1 | | CI_ResponsibleParty | Party responsible for generating the dataset. |
| optimumDisplayScale | 0..1 | | Integer | Not to be used by S-123 |

| | | | | |
|--------------------------|------|--------|-------------------------------|--|
| maximumDisplayScale | 0..1 | | Integer | |
| minimumDisplayScale | 0..1 | | Integer | |
| horizontalDatumReference | 1 | | CharacterString | EPSG |
| horizontalDatumValue | 1 | | Integer | 4326 |
| verticalDatum | 1 | | S100_VerticalAndSoundingDatum | (Must be nilled if possible. Ignored by applications, not relevant to S-123) |
| soundingDatum | 1 | nilled | S100_VerticalAndSoundingDatum | (Must be nilled if possible. Ignored by applications, not relevant to S-123) |
| dataType | 1 | GML | CharacterString | |
| otherDataTypeDescription | 0..1 | | CharacterString | |
| dataTypeVersion | 1 | 3.2.1 | CharacterString | |
| dataCoverage | 1..* | | S100_DataCoverage | |
| comment | 0..1 | | CharacterString | Any additional Information |
| layerID | 1..* | S-101 | CharacterString | Dataset must be used with ENC in an ECDIS |

Table 14-1 Dataset metadata

14.3 Update Dataset Metadata

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. The optional attribute updateApplicationDate is omitted since it is not applicable to update datasets.

| Name | Cardinality | Value | Type | Remarks |
|-------------------------------|-------------|------------|-----------------------|--|
| S100_DataSetDiscoveryMetadata | | | | |
| fileName | 1 | | CharacterString | Dataset file name (see 11.7) |
| filePath | 1 | | CharacterString | Full path from the exchange set root directory |
| description | 1 | | CharacterString | Brief description of the update. |
| dataProtection | 0..1 | {1} or {2} | CharacterString | Value must be same as base dataset. |
| protectionScheme | 0..1 | | CharacterString | Value must be same as base dataset. |
| digitalSignature | 0..1 | | CharacterString | |
| digitalSignatureReference | 0..1 | | CharacterString | |
| digitalSignatureValue | 0..1 | | CharacterString | |
| copyright | 0..1 | | MD_LegalConstraints - | Value must be same as base dataset. |

| | | | | |
|--------------------------|------|-------------------|---|---|
| | | | >MD_RestrictionCode <copyright> (ISO 19115) | |
| classification | 0..1 | | Class MD_SecurityConstraints>MD_ClassificationCode (odelist) | Value must be same as base dataset. |
| purpose | 1 | {3}, {4} | CharacterString | 3. Update 4. Cancellation |
| specificUsage | 1 | | MD_USAGE>specificUsage (character string) MD_USAGE>userContactInfo (CI_ResponsibleParty) | brief description of the resource and/or resource series usage |
| editionNumber | 1 | {1} | Integer | Value must be same as base dataset. |
| updateNumber | 1 | | CharacterString | Update sequence number, must match file name. |
| issueDate | 1 | | Date | Date on which the data was made available by the data producer |
| productSpecification | 1 | S-123 version N.n | CharacterString | Value must be same as base dataset. |
| producingAgency | 1 | | CI_ResponsibleParty | Party responsible for generating the dataset. |
| horizontalDatumReference | 1 | | CharacterString | EPSG |
| horizontalDatumValue | 1 | | Integer | 4326 |
| verticalDatum | 1 | | S100_VerticalAndSoundingDatum | (Must be nilled if possible - ignored by applications, not relevant to S-123) |
| soundingDatum | 1 | | S100_VerticalAndSoundingDatum | (Must be nilled if possible - ignored by applications, not relevant to S-123) |
| dataType | 1 | GML | CharacterString | |
| dataTypeVersion | 1 | 3.2.1 | CharacterString | |
| dataCoverage | 1..* | | S100_DataCoverage | |
| comment | 0..1 | | CharacterString | Any additional Information |
| layerID | 1..* | S-101 | CharacterString | Value must be same as base dataset. |

Table 14-2 Update dataset metadata

14.4 Support file Metadata

Support file metadata is intended to describe information about a data resource. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of a data resource.

| Name | Cardinality | Value | Type | Remarks |
|-----------------------------------|-------------|-------|-------------------------------|---|
| S100_SupportFileDiscoveryMetadata | | | | |
| fileName | 1 | | CharacterString | |
| fileLocation | 1 | | CharacterString | Path relative to the root directory of the exchange set. The location of the file after the exchange set is unpacked into directory <EXCH_ROOT> will be <EXCH_ROOT>/<filePath>/<filename> |
| purpose | 1 | | S100_SupportFilePurpose | new, replacement, or deletion. |
| editionNumber | 1 | | CharacterString | When a dataset is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition. Edition number remains the same for a re-issue |
| issueDate | 1 | | Date | |
| supportFileSpecification | 1 | | S100_SupportFileSpecification | |
| dataType | 1 | | S100_SupportFileFormat | |
| otherDataTypeDescription | 0..1 | | CharacterString | |
| dataTypeVersion | 1 | | CharacterString | |
| comment | 0..1 | | CharacterString | |
| digitalSignatureReference | 0..1 | | CharacterString | Reference to the appropriate digital signature algorithm |
| digitalSignatureValue | 0..1 | | CharacterString | |

Table 14-3 Support file metadata

14.5 Exchange Set Metadata

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

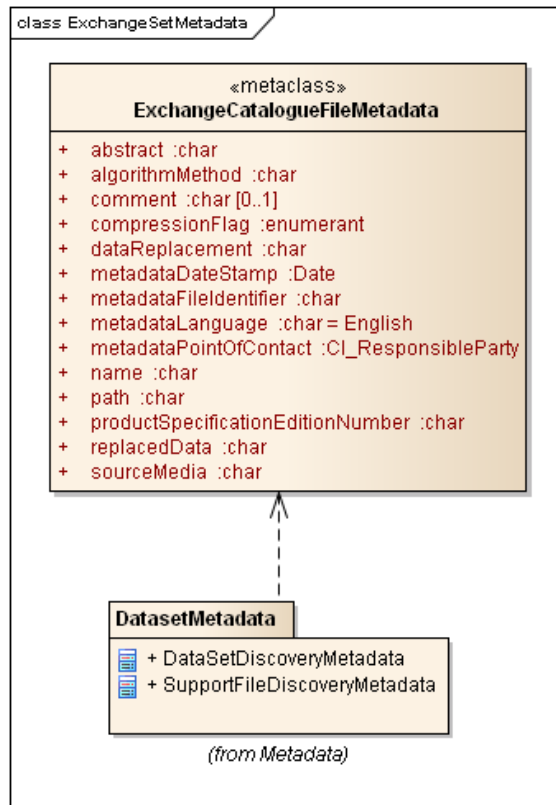


Figure 28 - Exchange set metadata

14.6 Catalogue File Metadata.

All S-123 Catalogue metadata files must contain at least the following metadata elements.

| Name | Cardinality | Value | Type | Remarks |
|------------------------------|-------------|-----------------|------------------------------|---|
| S100_ExchangeCatalogue | | | | |
| identifier | 1 | | S100_CatalogueIdentifier | |
| contact | 1 | | S100_CataloguePointOfContact | |
| productSpecification | 0..1 | | S100_ProductSpecification | Conditional on all the datasets using the same product specification |
| metadataLanguage | 1..2 | English, French | CharacterString | All datasets conforming to this PS must use English language. The catalogue file must be in English with the optional addition of French. |
| exchangeCatalogueName | 1 | CATALOG.123.XML | CharacterString | Catalogue filename |
| exchangeCatalogueDescription | 1 | | CharacterString | |

| | | | | |
|--------------------------|------|--|-----------------|----------------------------|
| exchangeCatalogueComment | 0..1 | | CharacterString | Any additional Information |
| compressionFlag | 0..1 | | Boolean | Yes or No |
| algorithmMethod | 0..1 | | CharacterString | For example. RAR or ZIP |
| sourceMedia | 0..1 | | CharacterString | |
| replacedData | 0..1 | | Boolean | |
| dataReplacement | 0..1 | | CharacterString | |

Table 14-4 Catalogue file metadata

Appendix C. Feature Catalogue

Name: Radio Services Feature Catalogue

Scope:

Version Number: 1.0.0

Version Date: 2017-08-31

Producer:

International Hydrographic Organization,
4 quai Antoine 1er,
B.P. 445
MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
Telefax: + 377 93 10 81 40

Language: English

(See Annex with review print of Feature Catalogue.)

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Appendix D-1. GML Data Format Overview

This data format conforms to the profile described in S-100 Part 10b, which is based on GML. Each dataset in the XML dataset format consists of a root or container element DataSet, whose structure is shown in the figure below. A Dataset contains optional header information identifying the dataset (contained in element DataSetIdentificationInformation) and providing parameters (within element DataSetStructureInformation), followed by 0 or more spatial objects (points, curves, or surfaces – these replace the S100:Geometry box in the figure), then information and feature objects (within imember and member container elements respectively). Dataset, imember, and member elements are format constructs and not part of the application schema. Also, the root Dataset element is derived from gml:AbstractFeatureType (another GML data format idiom). The figure below shows the top-level structure of a dataset.

The top-level Dataset element includes the dataset bounding box (*gml:boundedBy* - not required by the application schema, but used by GML off-the-shelf software).

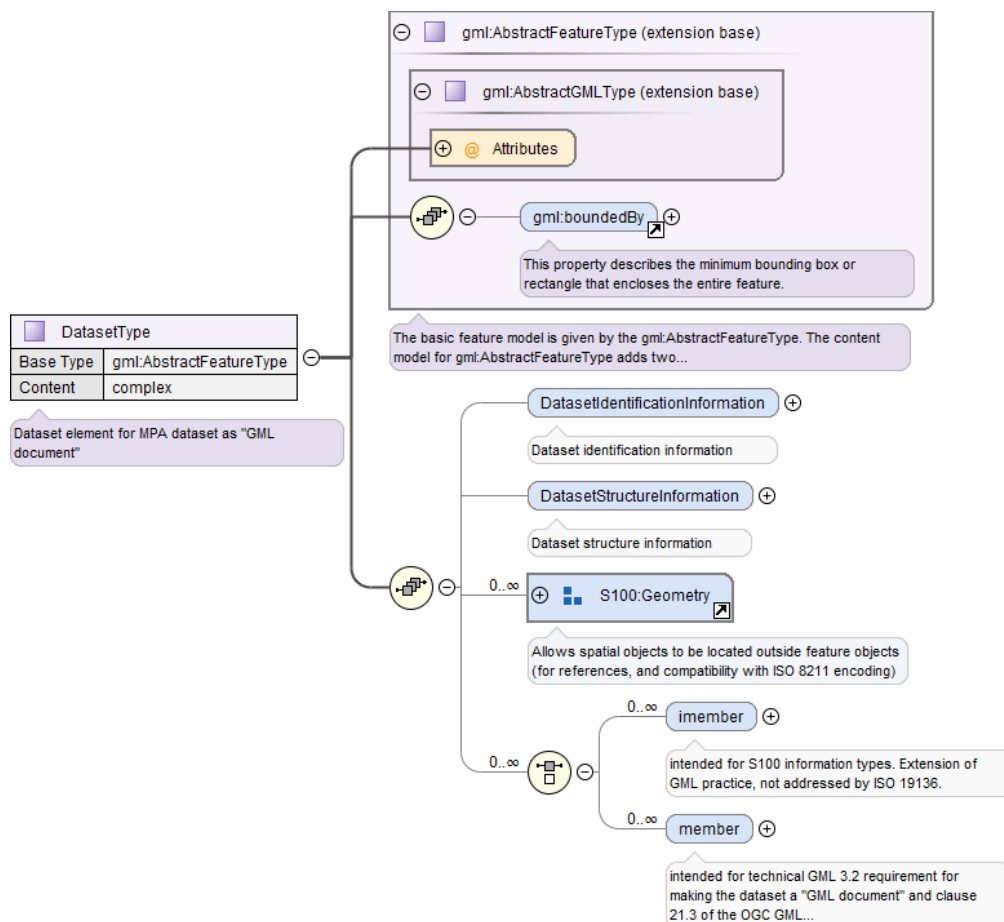


Figure 29 - Top-level structure of dataset

Feature and information type instances are placed in <member> and <imember> containers respectively. The figures that follow show the allowed feature and information instances respectively. Following GML idiom, the schema uses the XML substitution groups mechanism to include the allowed feature and information types.

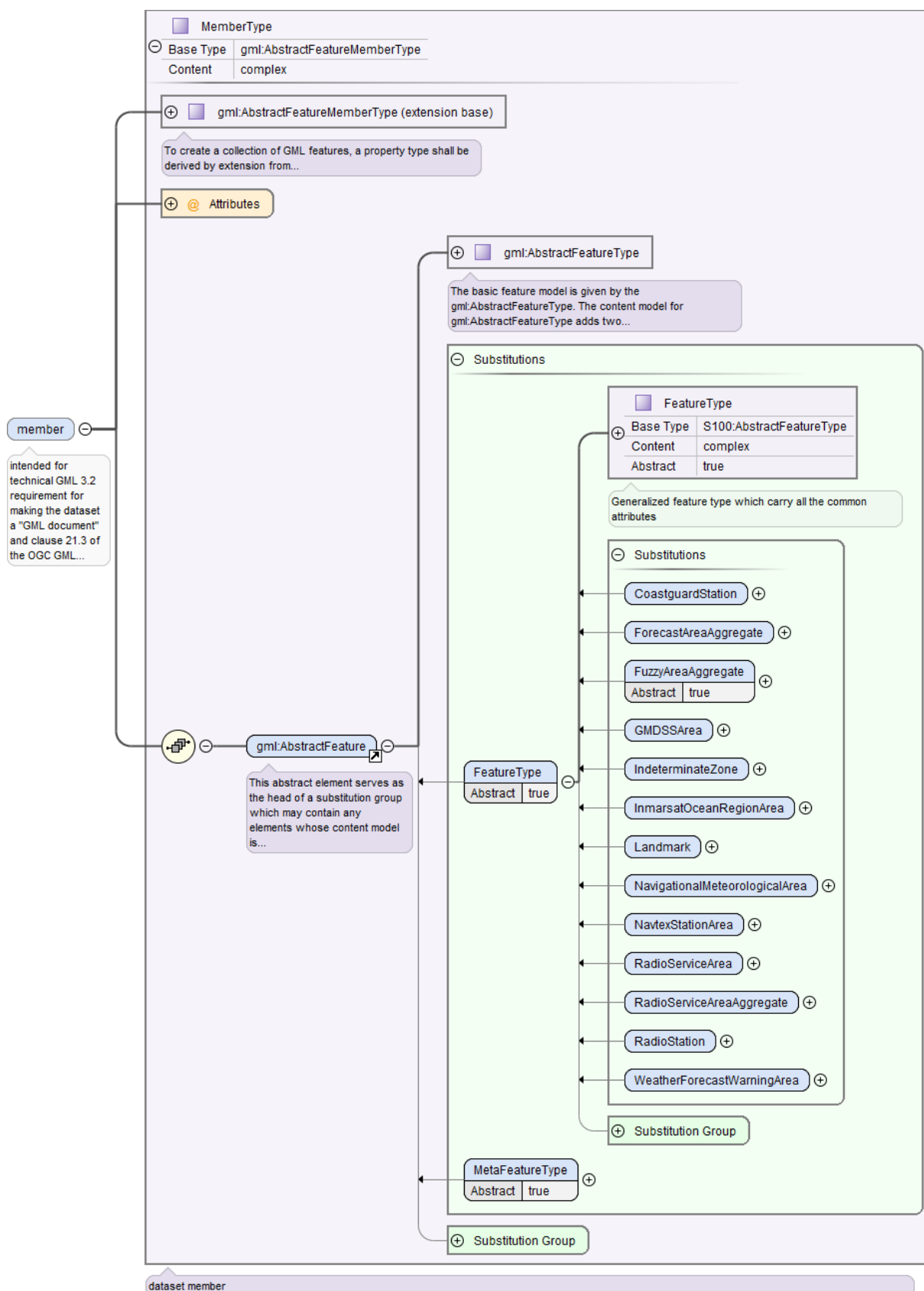


Figure 30. Features in the data format

Note that even when abstract feature types are included in the substitution groups, they act only as stand-ins for their non-abstract sub-types. This means that for example, there cannot

be any instances of **FuzzyAreaAggregate** itself – instead, it acts as a stand-in for its non-abstract subtypes **ForecastWarningAreaAggregate** and **RadioServiceAreaAggregate**,

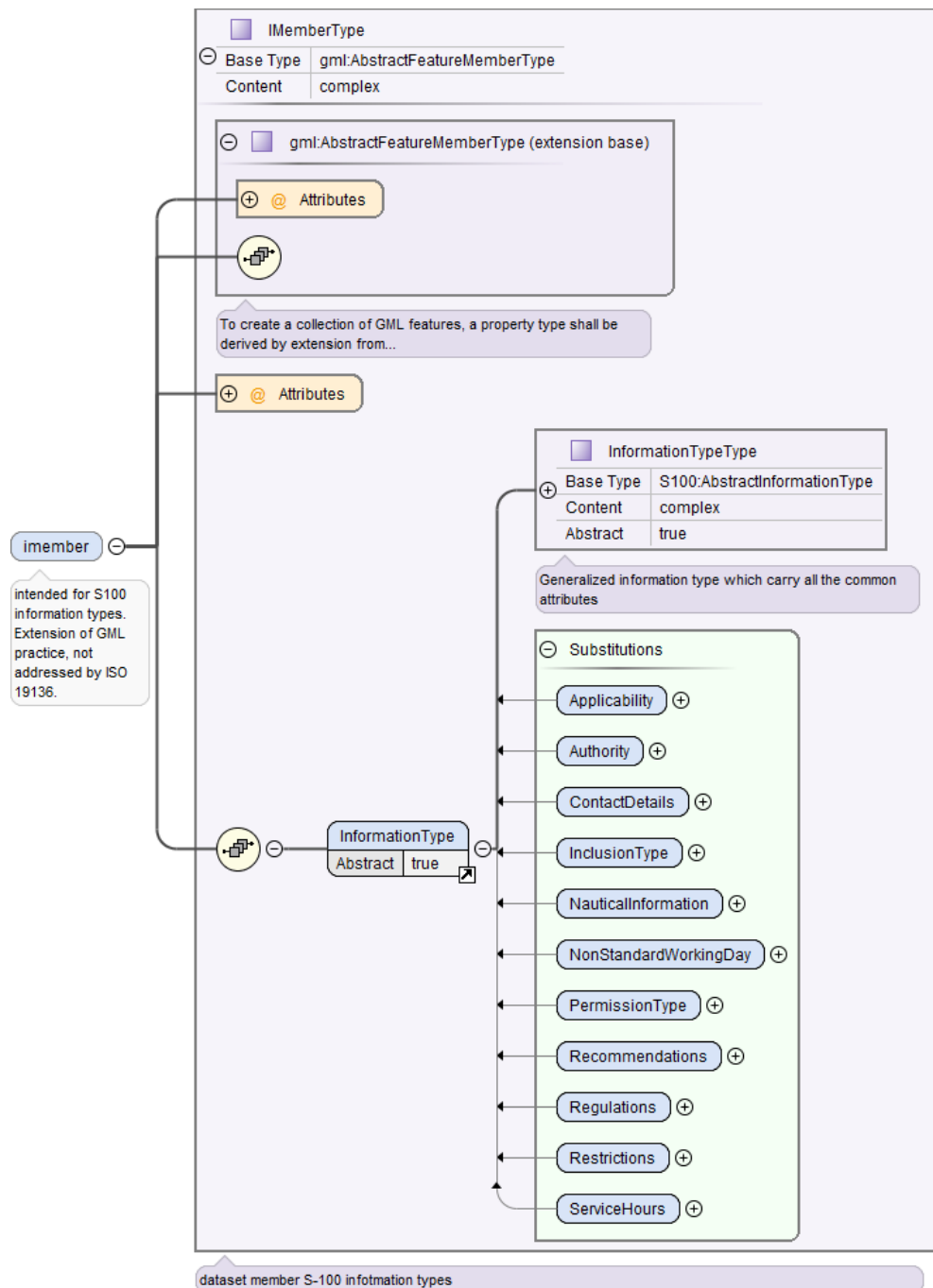


Figure 31. Information types in the data format

The structure of an example feature is shown in Figure 32. The **RadioServiceArea** feature inherits the attributes of the S-123 abstract feature **FeatureType**, which in turn is derived from generic S-100 type defined in the GML profile described in S-100 Part 10b; that in turn derives from the GML *AbstractFeature* type. **RadioServiceArea** therefore inherits attributes from S-123 abstract type **FeatureType** (attributes **fixedDateRange**, **periodicDateRange**, **featureName**, **sourceIndication**, **textContent**) as also its associations (**permission**, **providesInformation**, **positions**.) It also inherits the generic attributes and associations bound in the S-100 GML profile (*featureObjectIdentifier*, etc.). Attributes and associations

bound locally in the **RadioServiceFeature** (**callSign**, etc.) are shown below the parent types in the figure.

Detailed documentation generated from the XSD file accompanies this specification as a separate document (Appendix D-2).

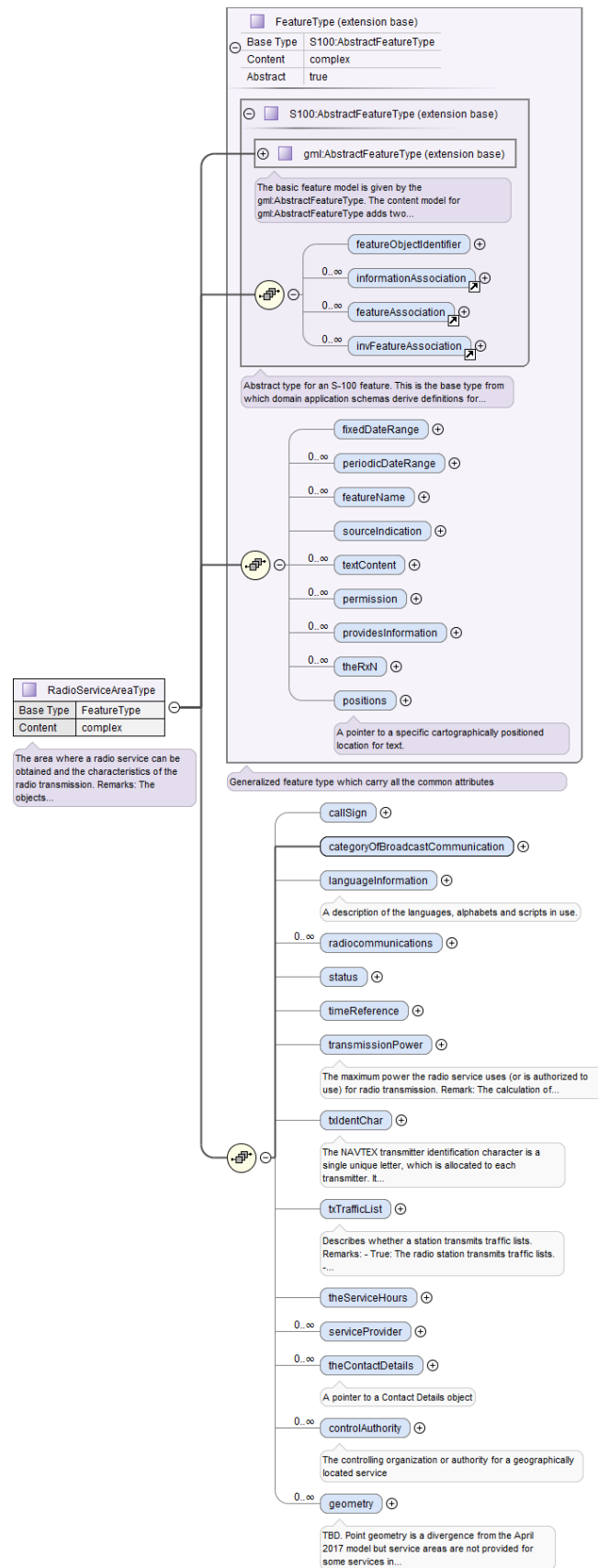


Figure 32. Structure of Radio Service Area feature in the GML data format

The figure below shows an example of a **RadioServiceArea** feature instance. This feature is associated to three **RadioStation** feature instances (the three tags `<serviceProvider>` with the target feature instance indicated by the `xlink:href="..."` attributes). The `serviceProvider` tag also contains an `xlink:arcrole` XML attribute whose value indicates the role.

```
<S123:RadioServiceArea gml:id="JS.RDOSVC.09">
  - <S100:featureObjectIdentifier>
    <S100:agency>JS</S100:agency>
    <S100:featureIdentificationNumber>111246</S100:featureIdentificationNumber>
    <S100:featureIdentificationSubdivision>1</S100:featureIdentificationSubdivision>
  </S100:featureObjectIdentifier>
  - <featureName>
    <language>eng</language>
    <name>MARITIME TELEMEDICAL ASSISTANCE SERVICE (TMAS)</name>
  </featureName>
  - <textContent>
    - <information>
      <language>eng</language>
      <text>The Maritime Search and Rescue Service is under the command of the Jusslander NAVY. Attention is drawn to the International Code of Signals, Medical Section.</text>
    </information>
  </textContent>
  <categoryOfBroadcastCommunication>non-commercial</categoryOfBroadcastCommunication>
  <languageInformation>Jusslandish, English</languageInformation>
  - <radiocommunications>
    <categoryOfRadioMethods>Very High Frequency (VHF) Digital Selective Call traffic</categoryOfRadioMethods>
    <categoryOfRadioMethods>High Frequency (HF) Digital Selective Call traffic</categoryOfRadioMethods>
    <categoryOfRadioMethods>Medium Frequency (MF) Digital Selective Call traffic</categoryOfRadioMethods>
    <contactInstructions>Jussland MRCC : DSC A1 A2 A3 MMSI 005742029</contactInstructions>
    <transmissionContent>Maritime telemedical assistance</transmissionContent>
  </radiocommunications>
  - <radiocommunications>
    <categoryOfRadioMethods>Very High Frequency (VHF) Digital Selective Call traffic</categoryOfRadioMethods>
    <categoryOfRadioMethods>High Frequency (HF) Digital Selective Call traffic</categoryOfRadioMethods>
    <categoryOfRadioMethods>Medium Frequency (MF) Digital Selective Call traffic</categoryOfRadioMethods>
    <contactInstructions>Bonbonkrema MRSC : DSC A1 A2 A3 MMSI 005742030</contactInstructions>
    <transmissionContent>Maritime telemedical assistance</transmissionContent>
  </radiocommunications>
  - <radiocommunications>
    <categoryOfRadioMethods>Very High Frequency (VHF) Digital Selective Call traffic</categoryOfRadioMethods>
    <categoryOfRadioMethods>High Frequency (HF) Digital Selective Call traffic</categoryOfRadioMethods>
    <categoryOfRadioMethods>Medium Frequency (MF) Digital Selective Call traffic</categoryOfRadioMethods>
    <contactInstructions>Bonbonkrema (ZZZ) : DSC A1 A2 A3 MMSI 005742031</contactInstructions>
    <transmissionContent>Maritime telemedical assistance</transmissionContent>
  </radiocommunications>
  <serviceProvider xlink:arcrole="http://www.iho.int/S-123/gml/1.0/roles/serviceProvider" xlink:href="#JS.RDOSTA.01"/>
  <serviceProvider xlink:arcrole="http://www.iho.int/S-123/gml/1.0/roles/serviceProvider" xlink:href="#JS.RDOSTA.02"/>
  <serviceProvider xlink:arcrole="http://www.iho.int/S-123/gml/1.0/roles/serviceProvider" xlink:href="#JS.RDOSTA.03"/>
  <theContactDetails xlink:arcrole="http://www.iho.int/S-123/gml/1.0/roles/serviceProvider"
    xlink:href="#JS.CONDET.01"/>
  <theContactDetails xlink:arcrole="http://www.iho.int/S-123/gml/1.0/roles/serviceProvider"
    xlink:href="#JS.CONDET.02"/>
  - <geometry>
    + <S100:surfaceProperty>
  </geometry>
</S123:RadioServiceArea>
```

Figure 33 - Extract from sample GML dataset

Notes:

- 1) Directed associations in the application schema may be encoded only in the instance at the source end. Encoding the reverse link (target to source) is optional. This is for compatibility with other encodings.
- 2) As of S-100 edition 3.0.0, feature catalogues do not allow feature bindings to be added to information types because the S-100 GFM does not permit information types to have feature bindings, nor does the ISO 8211 encoding in S-100 Part 10a permit such. In the interests of consistency across encodings, reverse links between information types and feature types are not used in GML format. If it is necessary to encode such reverse links from an information type to a feature type, the generic *invInformationAssociation* element, which is defined in *S100:AbstractInformationType* in the S-100 profile for Edition 3.0.0 and is the base type for all information types.

The format for update datasets is the same as for base datasets. A replacement feature instance, information type instance, or spatial object will have the same `gml:id` XML attribute as the instance it replaces – GML applications can still distinguish between original and replacement by using the update dataset file name as a prefix to the `gml:id` value.

Dataset identification information

The dataset identification information header contains the following fields:

| Field | XML Tag | Value | Mult. | Type | Description |
|--------------------------------|------------------------------|---------------------|-------|----------------------------------|--|
| Encoding specification | encodingSpecification | 'S-100 Part 10b' | 1 | CharacterString | Encoding specification that defines the encoding |
| Encoding specification edition | encodingSpecificationEdition | "1.0" | 1 | CharacterString | Edition of the encoding specification |
| Product identifier | productIdentifier | "INT.IHO.S-123.1.0" | 1 | CharacterString | Unique identifier for the data product |
| Product edition | productEdition | "1.0" | 1 | CharacterString | Edition of the product specification |
| Application profile | applicationProfile | "1" | 1 | CharacterString | "1" – EN Profile |
| Dataset file identifier | datasetFileIdentifier | | 1 | CharacterString | The file name including the extension but excluding any path information |
| Dataset title | datasetTitle | | 1 | CharacterString | The title of the dataset |
| Dataset reference date | datasetReferenceDate | | 1 | date | The issue date of the dataset. Format: YYYY-MM-DD |
| Dataset language | datasetLanguage | "EN" | 1 | ISO 639-1 | The (primary) language used in this dataset |
| Dataset abstract | datasetAbstract | | 0..1 | CharacterString | The abstract of the dataset |
| Dataset topic category | datasetTopicCategory | | 1..* | MD_TopicCategoryCode (ISO 19115) | A set of topic categories |

Table D1-1. Dataset identification information header

Dataset structure information

The dataset structural information header is described in S-100 10b-9.6.2 and contains the fields listed in the table below.

| Subfield name | XML Tag | Default Value | Mult. | Type | Description |
|---|---------------------|---------------|-------|------------------|--|
| Dataset Coordinate Origin X | datasetCoordOriginX | 0.0 | 0..1 | Real | Shift used to adjust x-coordinate before encoding. Set to 0.0 if no shift is used. |
| Dataset Coordinate Origin Y | datasetCoordOriginY | 0.0 | 0..1 | Real | Shift used to adjust y-coordinate before encoding. Set to 0.0 if no shift is used. |
| Coordinate multiplication factor for x-coordinate | coordMultFactorX | 1 | 0..1 | Positive Integer | Floating point to integer multiplication factor for the x-coordinate or longitude. Set to 1.0 for coordinates encoded as decimal degrees without multiplication. |
| Coordinate multiplication factor for y-coordinate | coordMultFactorY | 1 | 0..1 | Positive Integer | Floating point to integer multiplication factor for the x-coordinate or longitude. Set to 1.0 for coordinates encoded as decimal degrees without multiplication. |
| Coordinate multiplication factor for z-coordinate | coordMultFactorZ | 1 | 0..1 | Positive Integer | Floating point to integer multiplication factor for the z-coordinate or depths or height. Set to 1.0 for heights encoded in metres as decimals without multiplication. |

| | | | | | |
|------------------------------------|--------------------|--|------|------------------|---|
| Number of Information Type records | nInfoRec | | 0..1 | Integer ≥ 0 | Number of information records in the dataset. Normally encoded by production tools. |
| Number of Point records | nPointRec | | 0..1 | Integer ≥ 0 | Number of point records in the dataset. Normally encoded by production tools. |
| Number of Multi Point records | nMultiPointRec | | 0..1 | Integer ≥ 0 | Number of multi point records in the dataset. Normally encoded by production tools. |
| Number of Curve records | nCurveRec | | 0..1 | Integer ≥ 0 | Number of curve records in the dataset. Normally encoded by production tools. |
| Number of Composite Curve records | nCompositeCurveRec | | 0..1 | Integer ≥ 0 | Number of composite curve records in the dataset. Normally encoded by production tools. |
| Number of Surface records | nSurfaceRec | | 0..1 | Integer ≥ 0 | Number of surface records in the dataset. Normally encoded by production tools. |
| Number of Feature Type records | nFeatureRec | | 0..1 | Integer ≥ 0 | Number of feature records in the dataset |

Table D1-2. Dataset structure information header