International Standard

ISO 19152-3

First edition
2024-07

Geographic information — Land Administration Domain Model (LADM) —

Part 3: Marine georegulation

Information géographique — Modèle du domaine de l'administration des terres (LADM) —

Partie 3: Géoréglementation marine

Reference number
ISO 19152-3:2024(en)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Geographic Information,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement), and in collaboration with the International Hydrographic Organization (IHO).

This edition of ISO 19152-3, together with all other parts in the ISO 19152 series, cancels and replaces the first edition (ISO 19152:2012), which has been technically revised. This document is a new part to the ISO 19152 series and makes no changes to the original ISO 19152:2007.

A list of all parts in the ISO 19152 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 19152:2012 specifically addressed the land registration aspects of land administration. This document (ISO 19152-3:2023) introduces the broader term "georegulation", which addresses any area of geographic information in which rights, restrictions or responsibilities (RRR) can be applied. Georegulation is the activity of delimiting and asserting control over geographical spaces through regulations. This document allows the objects of georegulation to be documented in a systematic and consistent manner. Although the broader term "georegulation" is used throughout the document, the main element of the title of the document remains “Land Administration Domain Model” to retain compatibility with the previous edition of the document.

This document addresses georegulation in the marine environment. Rights and obligations created by georegulation share a basic structure, as described in ISO 19152-1. Marine activity, including transportation, resource extraction and food production (fishing and marine aquaculture), is of great importance. Different rights and obligations can exist on the surface, in the water column and on the seabed. The model defined in this document can be used for marine cadastres as well as other use cases (such as conservation areas, living resources and fishery management areas, non-living resources management areas, seabed tenure, etc.), and to describe data in support of the United Nations Convention on the Law of the Sea (UNCLOS)[27] or other conventions, e.g. administrative areas described in support of safe navigation under the International Convention for the Safety of Life At Sea (SOLAS).[28]

The oceans are of importance to all humankind, and specific areas along coastlines are under the jurisdiction of nation states. The jurisdiction of coastal states extends to certain maritime zones. Users and states have rights, restrictions and responsibilities in specific zones. The area beyond coastal states’ zones is without exercise or claim of sovereignty and the rights regarding the resources are vested in mankind.[27] In specific cases there are private rights, such as the rights associated with fishing or resource extraction. Some individuals can have property rights on land adjacent to water potentially extending into the area covered by water. This can be described in a marine cadastre, described using the structures available in this document.

International marine rights are addressed in international treaties globally through UN conventions and between nations; in particular, the United Nations Convention on the Law of the Sea (UNCLOS).[27] Marine safety and navigation are addressed by the International Maritime Organization (IMO) international convention on Safety Of Life At Sea (SOLAS) 1974.[28] Other international conventions, treaties and national laws establish rights and obligations.

The International Hydrographic Organization is an international standards development organization that specializes in the marine space. It develops standards for safe navigation, marine jurisdictions, oceanography and other aspects of the marine space in close cooperation with other international organizations such as the UN DOALOS[29] and ISO. In particular it supports several UN conventions such as the UNCLOS[27] and the SOLAS[28] conventions in cooperation with the UN IMO.[30] Alignment between ISO International Standards for the marine space and the IHO is important.

United Nations’ Sustainable Development Goal 14C and United Nations’ General Assembly Resolution A/RES/59/24 directed the IHO to provide technical standards for maritime zones. The IHO supports standards development for oceanography, marine science and the UN SOLAS and the UNCLOS conventions.[31] In particular, as part of the S-100 Universal Hydrographic Data Model,[18] IHO has developed a series of standards and specifications that address the marine space.[32] These include IHO S-121[20] on maritime limits and boundaries and IHO S-122[33] on marine protected areas.

A characteristic of georegulation objects in the marine space is that their geometry structure can need to be aligned with IHO S-100[18] and ISO 19107. As such, there can be different “feature” types. This is in alignment with the way "feature" is defined in the general feature model from ISO 19109 and the approach to feature cataloguing defined in ISO 19110. For their geographic information aspects, the IHO suite of hydrographic standards is based on many of the ISO/TC 211 suite of Geographic Information documents, through S-100. S-121[20] on maritime limits and boundaries directly supports the UNCLOS[27] and is built upon the ISO 19152 series. Due to the close links between S-121[20] and the ISO 19152 series, this document makes direct reference to S-100 and S-121.

Since many of the rights and restrictions in the marine space come either from international or bi-national treaties, or national proclamations or laws, within the context of georegulation, it can be necessary to express the text or preamble of a treaty or law. A “governance” object has therefore been added to the administrative structure in this document to allow legal text to be associated with an administrative unit. In many cases the parties involved in rights, restrictions and responsibilities (RRR) relationships in the marine space are nations. This means that the code lists of types of parties and administrative units defined in other parts of the ISO 19152 series will not necessarily apply. Unique code lists have been defined to address the marine space. Further, treaties are often the reference source for both the administrative and spatial aspects, so the distinction between types of sources has been eliminated.

The ISO 19152 series is a general abstract model for Land Administrative Domain Model (LADM) systems. It provides a uniform way of describing national or other systems. The ISO 19152 series is implemented through profiles, such as country profiles, in accordance with ISO 19106. S-121[20] is a profile for the description of marine limits and boundaries (MLB) in the context of support for the SOLAS[28] and the UNCLOS[27] conventions supported by the IHO series of standards. This document has two conformance classes, one that directly supports the S-121 profile, and the other more general conformance class that supports other aspects of marine georegulation. The profile for MLB is defined in S-121. The support of other aspects of marine georegulation will require the development of specific profiles to address these other areas.

This document is a derived work, developed under a cooperative agreement with the IHO, based on S-121[20] and used with permission.

In accordance with the ISO/IEC Directives, Part 2, 2018, Rules for the structure and drafting of International Standards, in International Standards the decimal sign is a comma on the line. However, the General Conference on Weights and Measures (Conférence Générale des Poids et Mesures) at its meeting in 2003 passed unanimously the following resolution:

“The decimal marker shall be either a point on the line or a comma on the line.”

In practice, the choice between these alternatives depends on customary use in the language concerned. In the technical areas of geodesy and geographic information it is customary for the decimal point always to be used, for all languages. That practice is used throughout this document.

NOTE The direction of positive rotation used in this document is positive in a counter clockwise direction in alignment with ISO 19109 and ISO 19107. The IHO S-100 series of standards makes use of “Heading Orientation” which is positive in a clockwise direction. The user needs to be aware of this difference.

Geographic information — Land Administration Domain Model (LADM) —

Part 3:
Marine georegulation

1 Scope

This document specifies the concepts and structure for standardization for georegulation in the marine space.

This document addresses the information structures related to management of legal spaces (such as the international maritime limits and boundaries, marine living and non-living resources management areas, marine conservation areas, etc.) and their related rights and obligations.

This document establishes the common elements and basic schema to structure marine georegulation information system. It builds upon the common components defined in ISO 19152-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19152-1, *Geographic information — Land Administration Domain Model (LADM) — Part 1: Generic conceptual model*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19152-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
boundary
<marine_georegulation> delimitation between two or more zones

Note 1 to entry: A boundary involves two or more parties.

Note 2 to entry: Adapted from Reference [20].

3.1.2
curve
1-dimensional geometric primitive, representing the continuous image of a line

Note 1 to entry: The boundary of a curve is the set of points at either end of the curve. If the curve is a cycle, the two ends are identical, and the curve (if topologically closed) is considered to not have a boundary. The first point is called the start point, and the last is the end point. Connectivity of the curve is guaranteed by the "continuous image of a line" clause. A topological theorem states that a continuous image of a connected set is connected.

[SOURCE: ISO 19136-1:2020, 3.1.17]

3.1.3
limit
<marine_georegulation> curve that defines a boundary or extent of a zone

Note 1 to entry: A limit involves one party.

Note 2 to entry: Adapted from Reference [20].

3.1.4
marine
relating to navigation or shipping or relating to or connected with the sea or used, or adopted for use at sea

Note 1 to entry: Sometimes called "maritime", but maritime is more frequently applied to that which borders on the sea.

[SOURCE: Reference [22]]

3.1.5
marine cadastre
management tool which spatially describes, visualizes and realizes formally and informally defined boundaries and associated rights, restrictions and responsibilities in the marine environment

Note 1 to entry: In addition to boundaries, a marine cadastre can also address locations, limits, baselines, zones and spaces.

Note 2 to entry: A marine cadastre is a type of georegulation related to property registration as addressed in ISO 19152-2 where the concept of "land" is extended to include "over water".

Note 3 to entry: Adapted from Reference [17].

3.1.6
marine georegulation
expression of a right, restriction or responsibility for one or more parties or group parties for a spatial location, boundary, zone or space in the marine domain

3.1.7
maritime
bordering on, or concerned with, or related to the sea

[SOURCE: Reference [22]]

3.2 Abbreviated terms

BAUnit	basic administrative unit
CRS	coordinate reference system
DOALOS	Division of Ocean Affairs and the Law of the Sea, office of legal affairs, United Nations
ENC	Electronic Nautical Chart
GIS	geographic information system

guid	globally unique identifier
IALA	International Association of marine aids to navigation and Lighthouse Authorities
IETF	Internet Engineering Task Force
IHO	International Hydrographic Organization
IMO	International Maritime Organization of the United Nations
LADM	Land Administration Domain Model
MLB	marine limits and boundaries
MRN	Maritime Resource Name
Oid	object ID
RRR	right, restriction, responsibility
SOLAS	International Convention on Safety of Life at Sea
UML	Unified Modelling Language
UNCLOS	United Nations Convention on the Law Of the Sea
uom	units of measure
URI	Uniform Resource Identifier
URN	Uniform Resource Name

4 Conformance

4.1 Conformance requirements and testing

Conformance to this document consists of alignment with the requirements established in 4.3 and 4.4. The abstract test suite given in Annex A describes a methodology which shall be used for testing conformance to these requirements.

4.2 Conformance classes

Two conformance classes are identified in this document:

— one for the description of a LADM marine georegulation system in support of maritime limits and boundaries for the UNCLOS

— one in support of other marine georegulation domain areas as outlined in Annex B.

The conformance class for a marine georegulation system in support of maritime limits and boundaries for the UNCLOS[27] provides a general model that is used by S-121.[20] This includes code lists and other structures, such as the governance class MG_Governance and the attribute type Marine Resource Name (MRN) as defined in S-100,[18] and geometry constraints to align with S-101.[19] The more general conformance class for other types of marine georegulation permits but does not require the use of the code lists and other structures specific to maritime limits and boundaries for the UNCLOS. These code lists and structures can be extended, or other code lists and structures can be included. Where compatibility is desirable between data products that conform with conformance class 1 and extensions that conform with conformance class 2, it is desirable that extensions be used. These two conformance classes are not mutually exclusive, but rather by making use of extensions it is possible to support both conformance criteria. Support

for the geometric constraints described in 7.2 is required for any marine georegulation data product that supports compatibility with the S-100-based suite of Electronic Nautical Chart (ENC) navigation standards.

4.3 Conformance class 1 — Marine limits and boundaries in support of the UNCLOS

Requirement 1: The description of a LADM marine georegulation schema in support of maritime limits and boundaries for the UNCLOS using this document (ISO 19152-3) shall consist of a set of UML classes with associated attributes that make use of or subtype the classes defined in Clause 8 including the code lists defined in 8.4.6, 8.4.7, 8.5.4, 8.5.14.7, 8.8.16, 8.8.27, 8.8.34, and 8.8.35, the attribute Marine Resource Name defined in 8.3 and the geometry constraints defined in 7.2 which are enumerated in Annex B.

NOTE The IHO standard S-121[19] conforms to conformance class 1 of this document.

4.4 Conformance class 2 — General marine georegulation

Requirement 2: The description of a LADM marine georegulation schema for general application, such as for marine cadastre or any of the other marine contexts described in Annex B using this document (ISO 19152-3) shall consist of a set of UML classes with associated attributes that make use of or subtype the classes defined in Clause 8. This allows for other marine georegulation application areas to be addressed that are not covered in S-121[20] or in the UNCLOS.[27] For example, seabed resource extraction would be an area that can be addressed by this conformance class. However, to do this, all of the code list values that pertain to this other application area would need to be defined as part of the specification of that application. The code lists, the attribute Marine Resource Name and the geometry constraints identified in conformance class 2 are optional and can be replaced with other code lists and geometric constraints.

5 Notation

The conceptual schema specified in this document is described using the Unified Modelling Language (UML), following the guidance of ISO 19103. The description of the types of relationships, such as subtyping, inheritance, and realization are described in ISO 19103, not in this document.

Several model elements used in this schema are defined in other ISO geographic information International Standards. By convention within some ISO/TC 211 documents, names of UML classes, with the exception of basic data type classes, include a two-letter prefix that identifies the document and the UML package in which the class is defined. This provides a global unique name for the class. UML classes defined in this document have the two-letter prefix of MG. The two-letter prefix of LA is used for ISO 19152-1 and ISO 19152-2 to support backward compatibility. Table 1 lists the other International Standards and packages in which UML classes used in this document have been defined.

Table 1 — Sources of externally defined UML classes

Prefix	Document	Part
CI	ISO 19115-1	Metadata — Fundamentals
DQ	ISO 19157-1	Data quality — General requirements
GM	ISO 19107	Spatial schema
LA	ISO 19152-1	Generic conceptual model
LA	ISO 19152-2[a]	Land registration
MG	ISO 19152-3	Marine georegulation

[a] Under preparation. Stage at the time of publication ISO/DIS 19152-2:2024.

NOTE ISO 19157-1 and ISO 19107 have dropped the prefixes GM and DQ, relying on context for the uniqueness of class names. However, the prefixes are still used in the older versions of these documents, which are still referenced by some external standards, such as versions of S-100.[18] Retaining the prefixes in Table 1 provides an understanding of the meaning of these prefixes when they are encountered. They are required for backward compatibility.

The following stereotypes are used to identify attributes that apply to specific conformance classes.

<<MLB>> — This stereotype applies to attributes that are specific to conformance class 1 relating to maritime limits and boundaries in accordance with S-121.[20]

<<MRN>> — This stereotype applies to attributes used to carry the Maritime Resource Name, which is a specific identifier managed by the IHO and defined for the S-100 suite of standards, including S-121.[20]

6 Context

The purpose of this document is to establish a structure for the description of georegulation in the marine space.

Jurisdictions in the marine space can be different from those on land and can be covered by international conventions such as the UN Convention on the Law of the Sea (UNCLOS).[27] The UNCLOS defines the marine zones and the rights and duties of a country regarding those zones. Other treaties and agreements between nations and national instruments define specific aspects of georegulation in the maritime space, including, among other subjects, fisheries, passage, exploration and exploitation.

Although georegulation in the marine space can be different from land administration, the same underlying structure of rights, restrictions and responsibilities (RRR) established in ISO 19152-1 apply. There can be different rights assigned to the seafloor, the water column and the surface within different zones. An example is the “right of innocent passage” as described in the UNCLOS, Article 17 which is subject to restrictions as described in Article 19.[27] However, in some cases, individuals or corporations can also have rights, such as the fishing rights or exploration rights granted by nations in their waters or multilateral bodies. In some nations, property rights on land adjacent to water can extend into areas covered by water and property rights can exist in the water.

In the international context, some RRRs in the marine space derive from treaties between nations, where the nations are the parties. Other RRRs can derive from national instruments such as laws or government declarations. RRRs can also derive from marine property rights expressed using a marine cadastre. International treaties and national instruments or other sources can be referenced using the “source” construct described in ISO 19152-1. However, it is sometimes necessary to include the associated legal text in the marine space georegulation dataset. In order to accommodate this, a “Governance” object has been added to the structure in this document to contain legal text that is associated with an administrative unit. Often treaties and national marine regulations serve as both the administrative and spatial source.

This document uses a feature-oriented approach for spatial geometry in alignment with the general feature model defined in ISO 19109. Features are defined in accordance with ISO 19110. The features can be locations, limits, zones or spaces with associated spatial geometry as defined in ISO 19107. For example, a Base Line Point is a specific type of location represented as a point geometry. A zone such as the Exclusive Economic Zone [UNCLOS Part V][27] is represented as an area with surface geometry. A specific type of limit such as the “Outer Limit of the Territorial Sea"[UNCLOS Article 4][27] is represented as a line with curve geometry. This approach is similar to the approach taken in many other areas of geographic information and is fully supported by the ISO/TC 211 geometry model specified in ISO 19107.

There is a close relationship between marine georegulation as defined in this document and S-121.[20] The IHO has developed S-100[18] based on many of the ISO/TC 211 documents: it forms a profile of those documents applicable to the marine space, in particular in terms of the geometry, feature model, quality, metadata, coverage, portrayal and encoding specified. S-100 is quite broad, allowing for a number of specific product specifications to be developed addressing different areas related to safe navigation, oceanography and marine georegulation. However, S-100 does make specific selections with respect to spatial geometry and feature relations. These constraints allow for rigorous testing of marine Electronic Chart Display Information Systems to comply with the UN International Marine Organization (IMO) regulations.

The IHO series of standards referred to in this document support several UN conventions, in particular, the International convention for the Safety of Life at Sea (SOLAS)[28] and the UN Convention on the Law of the Sea (UNCLOS).[27] The SOLAS convention addresses safe navigation and the UNCLOS addresses maritime space and associated rights and responsibilities. Further to this, S-121[20] addresses the requirements of the Division of Ocean Affairs and the Law of the Sea, Office of Legal Affairs, United Nations (DOALOS)[29] for Maritime Limits and Boundaries. S-121 is based on the structures defined in ISO 19152-1 for RRR and party, making use of the Universal Hydrographic Model from S-100. The geometry and other constraints defined in S-100 also apply to S-121.

This document (ISO 19152-3) is broader than S-121, addressing additional marine georegulation application areas beyond international maritime limits and boundaries. However, to remain compatible with S-121 it abides by the same constraints as defined in S-100.

7 Feature and attribute structure

7.1 Structural overview

ISO 19152-1 describes a high-level model that establishes the basic structures for all aspects of land administration/georegulation. This document (ISO 19152-3) describes the specific model related to georegulation in the marine space. The marine space is diverse and includes marine limits and boundaries, navigation, resource management, oceanography, bathymetry and aspects of climatology such as tides and currents. Marine geographic information systems make use of the full spectrum of capabilities available in the geometry, general feature model, metadata, quality, encoding, portrayal, registration and the general aspects of land administration established in the ISO/TC 211 suite of geographic information documents. Some of these areas require the administration of rights, restrictions and responsibilities in a similar manner to the administration of land. In fact, in some cases it is more complex, where different rights or restrictions apply to different levels in the water column. For example, navigational rights can exist on the surface with fishing rights in the water column and mining rights on the bottom. These rights can apply to different parties and have complex interrelations.

The high-level conceptual model for marine georegulation is based on the general feature model defined in ISO 19109 and aligns with the conceptual model defined in S-100[18] with the addition of the rights, restrictions, responsibilities and parties structure defined in this document. There are many different types of features that occur in the marine space, including locations represented by point geometric spatial attributes, limits represented by geometric curves, zones represented by surface geometric spatial attributes and spaces represented by surface spatial attributes with height (or depth) as an attribute. The geometric primitives are defined in ISO 19107. This document (ISO 19152-3), which addresses the marine space, makes use of the subset of the spatial primitives defined in ISO 19107 that are also used in the S-100 Universal Hydrographic Model (S-100 Part 7 – Spatial Schema). This ensures alignment between the IHO standards and other uses of marine georegulation based on this document. In all aspects related to this document there is full compatibility with S-100.[18]

7.2 Geometry structure

IHO establishes certain constraints on the geometry used under S-100.[18] These represent a subset of the broader set of geometric primitives allowed in ISO 19107. The S-100-defined external constraints are given below. Product specifications developed in accordance with this document can be a profile of ISO 19107 and S-100.

NOTE 1 The following text is adapted from S-121:2019, 4.2.3.[20] In order to follow ISO editorial practice, the word "must" has been removed and each clause phrased as a description. References to internal figures within the S-121 document have been removed.

a) Each curve references a start and end point (they can be the same).

b) Curves shall not self-intersect.

c) Areas are represented by a closed loop of curves beginning and ending at a common point.

d) In the case of areas with holes, all internal features' geometric boundaries are completely contained within the external geometric boundary and the internal geometric boundaries do not intersect each other or the external geometric boundary. Internal geometric boundaries can touch other internal boundaries or the external geometric boundary tangentially (that is at one point).

e) The outer boundary of a surface shall be in a clockwise direction (surface to the right of the curve) and the curve orientation positive. The inner geometric boundary of a surface is in a counter-clockwise direction (surface to the right of the curve) and the curve orientation shall be negative.

This document follows list items a) to d) above, which conform to ISO 19107. However, in order to conform to ISO 19107, this document does not follow list item e). In data conforming to this document, the outer boundary of a surface is in a counter-clockwise direction and any inner boundaries are in a clockwise direction.

NOTE 2 The IHO S-100 series of standards makes use of “Heading Orientation” which is positive in a clockwise direction around the outside of a geometric boundary, as indicated in list item e) above. This is different from the convention used in the ISO/TC 211 documents, which use “Mathematical Orientation” which is positive in a counter-clockwise direction. This is an important distinction that could cause confusion. ISO 19152-3 operates using “Mathematical Orientation” which is positive in a counter-clockwise direction, consistent with all other ISO/TC 211 documents.

S-121[20] is constrained to 0, 1 and 2 dimensional features (points, curves and surfaces) as defined by S-100 Part 7.[18] The constraint is:

f) Only the geometry types Point, MultiPoint, Curve, Surface, Coverage, Curve (arcByCentrePoint and circleByCentrePoint) are used. MultiPoint is only used for hydrographic soundings and Coverage is limited to bathymetry and tides and currents. There is no Volume primitive used. This approach aligns with IHO S-100 and is needed for alignment with the IHO suite of standards. A volume is constructed out of a Surface primitive with a height attribute. This is commonly referred to as 2 1/2 Dimensions (i.e. 2 Dimensions with height as an attribute). These constraints permit a planar graph topology to be constructed. Also, Curve is constrained to be defined as a series of vertices, or one of two specific arcs (arcByCentrePoint and circleByCentrePoint). Systems that implement IHO standards for use at sea are required to undergo marine equipment conformance testing. Limiting the number of possible spatial primitives makes conformance testing possible.

This document allows but does not enforce the constraint expressed in list item f).

NOTE 3 Following this constraint in a product specification developed in accordance with this document allows for the inclusion of data from IHO S-121 to be used with other data products defined by IHO. This is the case for conformance clause 1 of this document. Other product specifications conforming to conformance clause 2 of this document are permitted to use any geometry structure permitted in ISO 19107 including the survey geometry structure used in some other parts of the ISO 19152 series.

7.3 Packages of ISO 19152-3 (this document)

This document makes use of the core packages defined in ISO 19152-1 together with a package addressing marine georegulation. The base package for this document is "ISO 19152-3 Edition 1 Marine Georegulation". This package has four subpackages, "MG_PartySection", “MG_Administrative", MG_SpatialUnit" and "MG_Source". These packages are realizations of the equivalent packages in ISO 19152-1. The package relationship structure is illustrated in Figure 1.

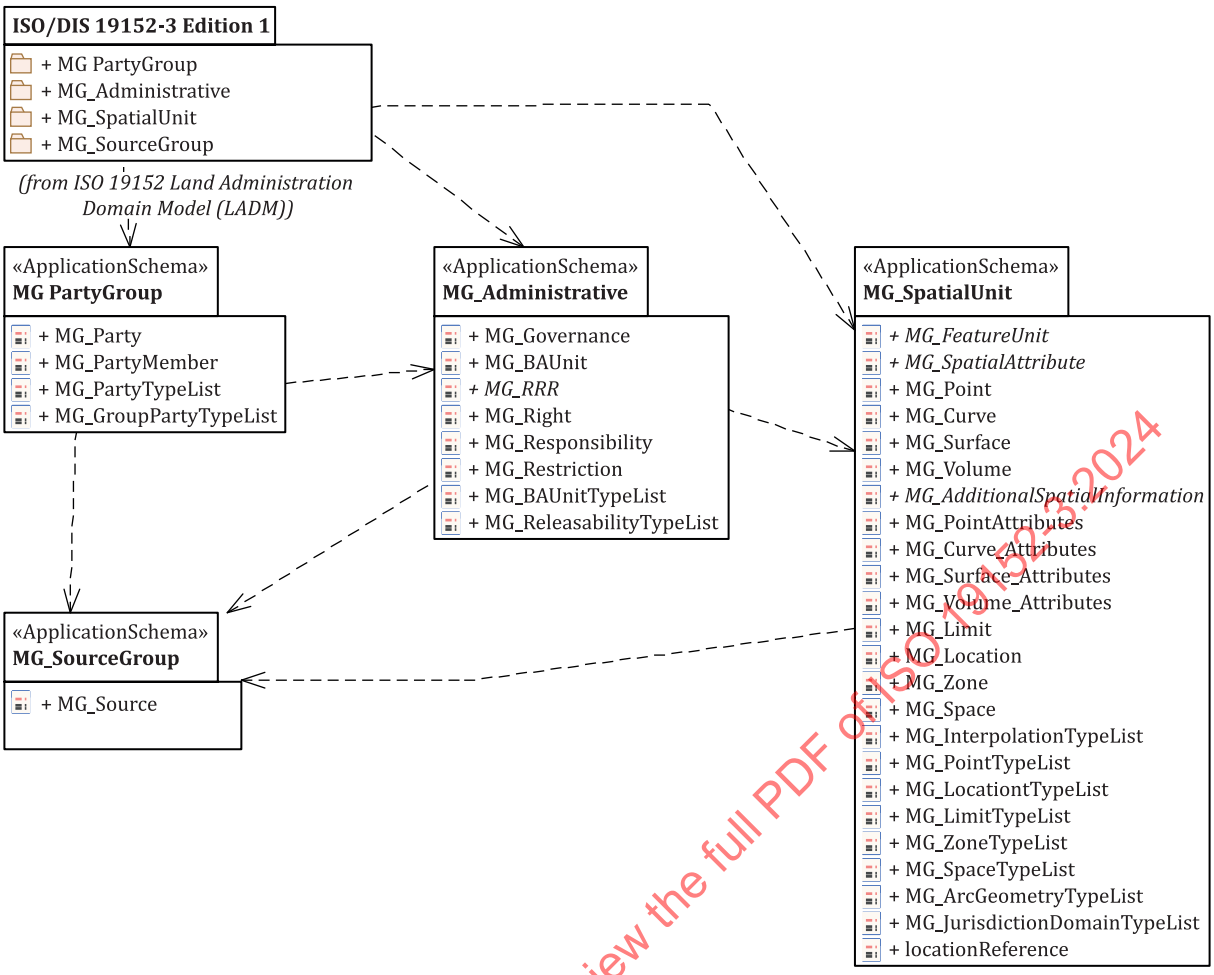

Figure 1 — Packages of the core LADM and marine georegulation

8 Marine georegulation application schema

8.1 Marine georegulation elements

This document describes an application schema model for managing rights, restrictions and responsibilities for georegulation within the marine space within the context of the LADM and also in alignment with the S-100 Universal Hydrographic Model and the IHO standard S-121 on Maritime Limits and Boundaries.[20]

The Marine Georegulation Application Schema uses the same feature and attribute model as defined in ISO 19110 and ISO 19126 and in S-100.[18] Feature types, attribute types and listed values for code lists and enumerations have their definitions recorded in a feature concept dictionary register in accordance with ISO 19126. These feature concepts are then used to construct a particular feature catalogue in accordance with ISO 19110 for a product specification defined in accordance with ISO 19131. This allows for different product specifications to be developed by various organizations to address different application areas within the marine space. This is also the normal process of the development of product specifications in accordance with ISO 19131.

For S-121,[20] the feature concept dictionary is established by the IHO as a register in accordance with ISO 19135-1. The IHO Geospatial Information Registry[21] is available online and as a document from the IHO. The ISO 19110-conformant feature catalogue for S-121 is available as Annex A to the S-121 document.

S-121 addresses maritime limits and boundaries. For other uses within the marine space, other feature catalogues and product specifications can be developed. For those application areas governed by the IHO, feature concepts are recorded in the IHO Geospatial Information Registry.[21] If other organizations or

nations develop applications addressing georegulation within the marine space they would similarly need to develop a feature catalogue (with or without a feature concept dictionary) and a product specification based on this document (ISO 19152-3).

ISO 19152-1 defines a structure to represent RRR, parties, sources and basic administrative units (BAUnits). This structure acts as a set of thematic attributes by reference. Complex structures can be modelled using these components, where different rights or restrictions apply to different levels in the water column. For example, navigational rights can exist on the surface with fishing rights in the water column and mining rights on the bottom. These rights can apply to different parties and have complex interrelations. This attribute structure can be shared. For example, several of the features in a marine georegulation data set can describe sovereign rights, and have common sources. This information only needs to be described once in the appropriate RRR, party or source object.

Another attribute structure inherited from ISO 19152-1 is the capability to version features. Versioning allows for individual features to be revised using a start and end date. An alternative approach is to version entire datasets using metadata. Both versioned features and versioned data sets can be used together.

Figure 2 shows the overall marine georegulation application schema model. The feature unit derives directly from ISO 19152-1 and takes on attributes defined in a feature catalogue established in accordance with ISO 19110. The spatial attribute type class takes on the spatial attribute types of MG_Point, MG_Curve, MG_Surface or MG_Volume. These spatial attributes take their geometry from ISO 19107 types Point, Curve and Surface.

This feature and attribute structure has a relationship to MG_Source, meaning that source information can be provided on any feature or spatial attribute. Features can also have a relationship to a BAUnit type feature. This allows RRR to be described and associated to parties or group parties. These can also be sourced.

The MG_Party is a non-spatial object. Individual parties are identified by the attribute values of the party features.

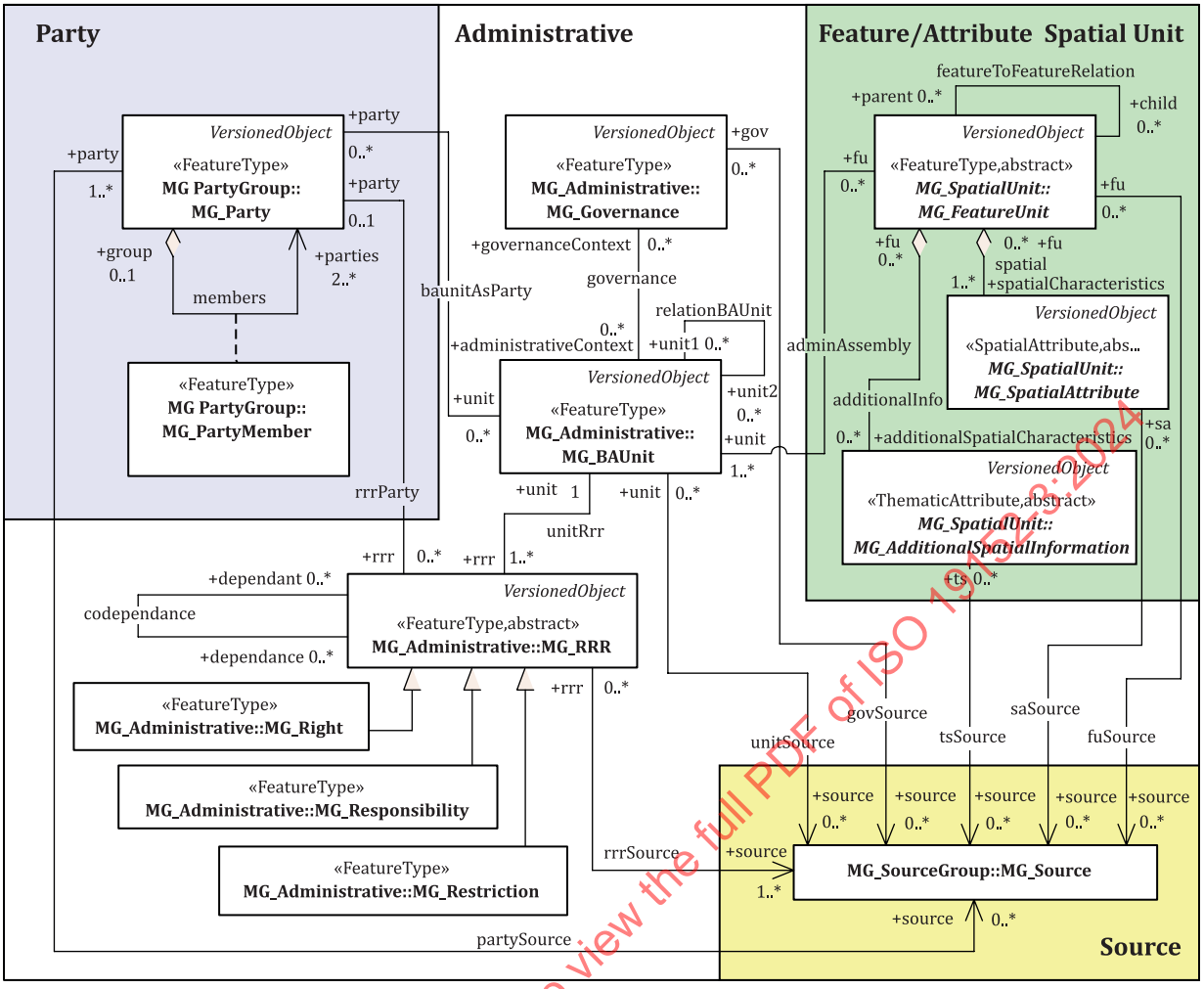

Figure 2 — Marine georegulation application schema model

Figure 2 shows the overall structure of the marine georegulation application schema. The four identified group sections correspond to the packages inherited from ISO 19152-1 with the feature structure from ISO 19109 and ISO 19110 implementing the spatial unit identified in ISO 19152-1. In addition, the MG_ Governance class has been included to augment the administrative group section.

8.2 Inherited core packages

The three packages from ISO 19152-1, Administrative, Party and Spatial Unit, are inherited by this document. The classes from each of these packages are specialized in this document to add attributes. This means that new classes need to be defined, realizing the inherited classes. These new classes take on names beginning with "MG_" to distinguish them from the core classes. There is only one package in this document, so all of the core elements are inherited into this one UML package.

The S-100 standard[18] introduces an optional attribute called a Maritime Resource Name (MRN). Adding this attribute to almost all classes in this document means that the whole structure is realized and all classes need to be named as "MG_" type classes. In fact, this makes it simpler to distinguish what is defined in this document and what is defined in the core model in ISO 19152-1.

8.3 MRN

For data management, there is sometimes a need for the global identification of some objects. The Maritime Resource Name (MRN) is an optional identifier in the marine space that is a permanent global identifier. Use of this identifier allows marine space management. The use of the MRN is required in conformance class 1 as described in 4.3.

This optional identifier is defined in S-100.[18] IHO provides guidance on the structure of the MRN as a Globally Unique Identifier (GUID) based on the Uniform Resource Identifier (URI) as defined in the Internet Engineering Task Force (IETF) recommendation, RFC 3986.[23] Users of this document (ISO 19152-3) can define their own URI in accordance with their own needs, or can participate in the structure managed by IHO. The type of URI used by IHO is a Uniform Resource Name (URN). A URN is a persistent, location-independent identifier assigned within a defined namespace. The root of a URN is registered to an organization that is responsible for the namespace. This URN root can be assigned to the country using marine georegulation product specification based on this document, or it can make use of the URN established by the IHO as a sub-branch of the URN root registered to the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA).

8.4 Party section

8.4.1 Party section general

A party is considered as an object which can be be shared. That is, a party can be part of several different RRRs. A group party, as defined in ISO 19152-1, is also a party that consists of several individual parties. The party member class provides an attribute on the composition attribute that forms a group out of several party members. This optional attribute allows parties to have different shares within a group.

The MG_Party class in this document is realized from LA_Party. MG_Party is a simplification of LA_Party and its subtype LA_GroupParty, containing both within one class using an attribute to distinguish them.

The types of MG_Parties are described by the code lists MG_PartyType and MG_PartyGroupType. These are specialized code lists for the marine georegulation (MG) domain. National systems may also extend these code lists within their own contexts.

Figure 3 shows the party section structure. The party structure defined for the MG domain inherits from the structure defined in ISO 19152-1 through a set of realization relationships.

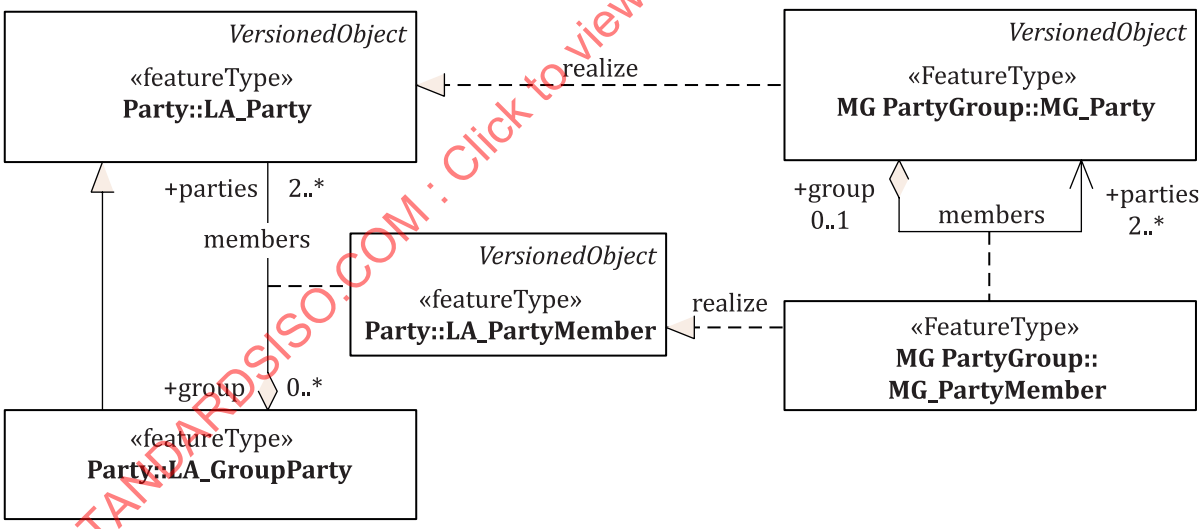

Figure 3 — Party section showing inheritance

Figure 4 shows the MG_Party section with attributes.

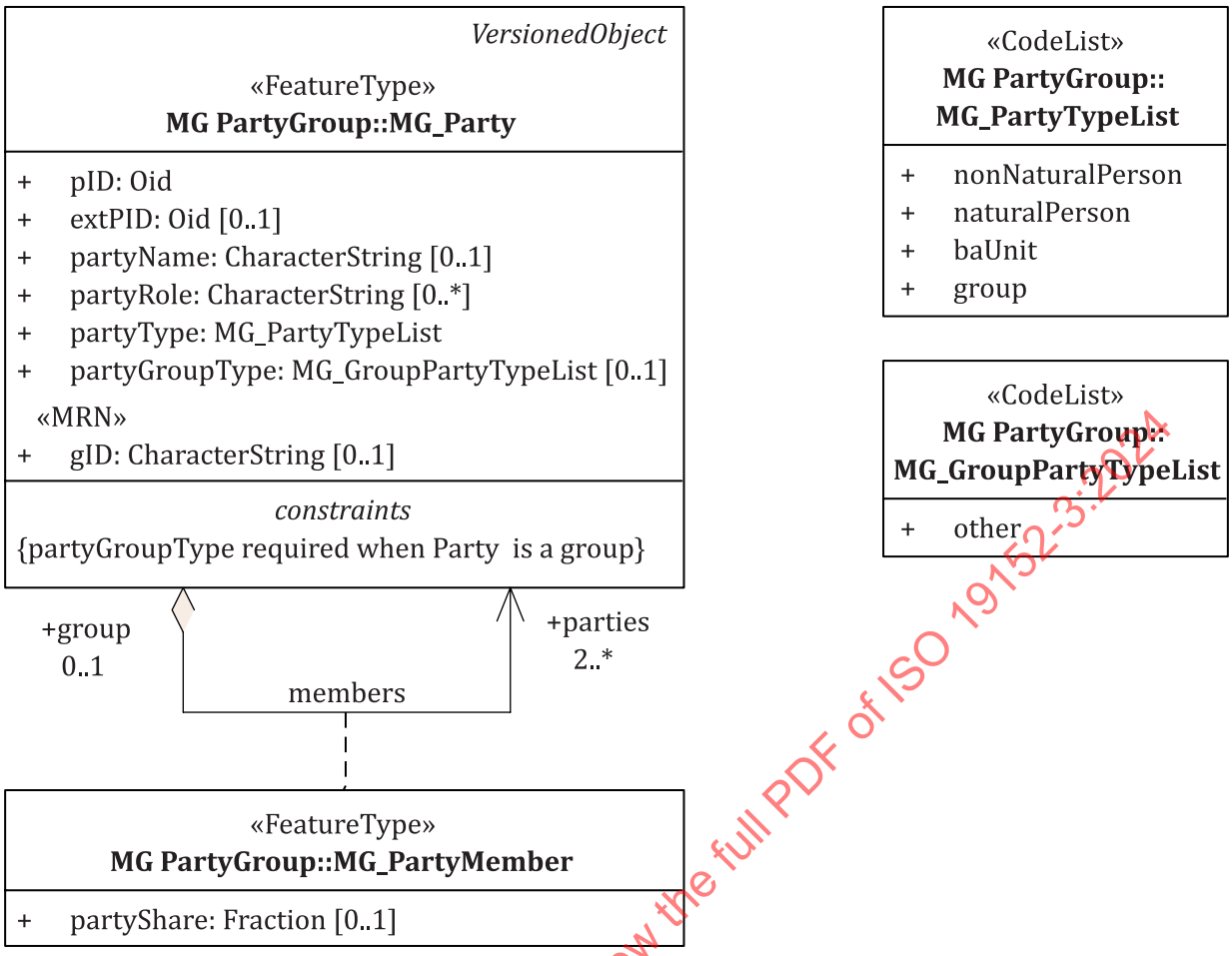

Figure 4 — Party section showing attributes

8.4.2 MG_Party

A party is a single person or organization. A group party can be composed of other instances of MG_Party. The PartyMember class provides an attribute on the composition attribute that forms a group out of several party members. This optional attribute allows parties to have different shares within a group. The types of parties and group parties are described by MG_PartyType and MG_PartyGroupType.

This class is realized from ISO 19152-1 "LA_Party" and "LA_GroupParty". This class is a realization because it inherits from LA_Party, but it can make use of different code lists than LA_Party suited to the marine environment. It is also a combination of both LA_Party and LA_GroupParty. LA_GroupParty describes any number of parties, forming together a distinct entity, with each party being independent. Since LA_GroupParty is a subtype of LA_Party, this is described as a single class, "MG_Party", that includes a conditional attribute "MG_partyGroupTypeList" that defines the type of a group party. This combined structure assists implementation.

This class takes on the following attributes and relations.

8.4.3 MG_Party attributes and relationships

8.4.3.1 pID

This attribute is the identifier of the party which allows reference to "Party" information objects using the “Oid” (Object ID) attribute type. The “Oid” comprises a unique character string and a namespace identifier which is also a unique character string.

EXAMPLE "Party-5" where "Party" is the namespace identifier, "-" is a delimiter and "5" is the unique ID within that namespace.

8.4.3.2 exID

This optional attribute is the identifier of the party in an external registration. The attribute type is also the “Oid” (Object ID) attribute type.

8.4.3.3 partyName

This optional attribute specifies the name of the party.

8.4.3.4 partyRole

This optional attribute describes the role of the party or roles with which the party is involved. The attribute type is a character string to permit any role or roles.

8.4.3.5 partyType

This attribute specifies the type of the party from the code list MG_PartyType. This code list is unique to the MG domain.

8.4.3.6 partyGroupType

This optional attribute specifies the type of the party group from the code list MG_GroupPartyType. This code list is unique to the MG domain.

A constraint indicates that the partyTypeGroup attribute is required when a party is a group.

8.4.3.7 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.4.3.8 membersRelationship

The optional composition relationship relates instances of the object MG_Party to other instances of itself to form group parties. This relationship includes a relationship class, MG_PartyMember. Navigation is defined from a group to its components, and optionally from the components to a group.

8.4.3.9 Realization relationship to LA_Party

There is a realization relationship to the general class LA_Party from ISO 19152-1, and its subtype LA_GroupParty, to form MG_Party in the MG domain.

8.4.4 MG_PartyMember

The class MG_Party is a relationship class which provides an attribute on the relationship members. It indicates that a party member is a fraction of a group party.

This class takes on the following attribute and relations.

8.4.5 MG_PartyMember attributes and relationships

8.4.5.1 partyShare

This attribute is the identifier of the party which allows reference to "Party" information objects using the “Oid” (Object ID) attribute type. The “Oid” comprises a unique character string and a namespace identifier which is also a unique character string.

EXAMPLE "Party-5" where "Party" is the namespace identifier, "-" is a delimiter and "5" is the unique ID within that namespace.

This optional attribute represents the fractional share of a group that a party member represents.

8.4.5.2 Realization relationship to LA_PartyMember

There is a realization relationship to the general class LA_PartyMember from ISO 19152-1 to form MG_PartyMember in the MG domain.

8.4.6 MG_PartyTypeList

The code list MG_PartyTypeList describes categories of MG_GroupPartyType that can be established in the MG domain based on the type of agreement under which the group was formed. The code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include all party types.

Specific values for this code list are defined for the maritime limits and boundaries domain established by S-121.[20] These are identified by the stereotype <MLB> for conformance class 1and listed in Annex B.

8.4.7 MG_GroupPartyTypeList

The code list MG_GroupPartyTypeList describes categories of MG_GroupPartyType that can be formed in the MG domain. The code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include all party types.

Specific values for this code list are defined for the maritime limits and boundaries domain established by S-121.[20] These are identified by the stereotype <MLB> for conformance class 1 and listed in Annex B.

8.4.8 Special data types

8.4.8.1 Special data types general

Figure 5 shows the special data type classes Oid and Fraction that are used as data types within this model.

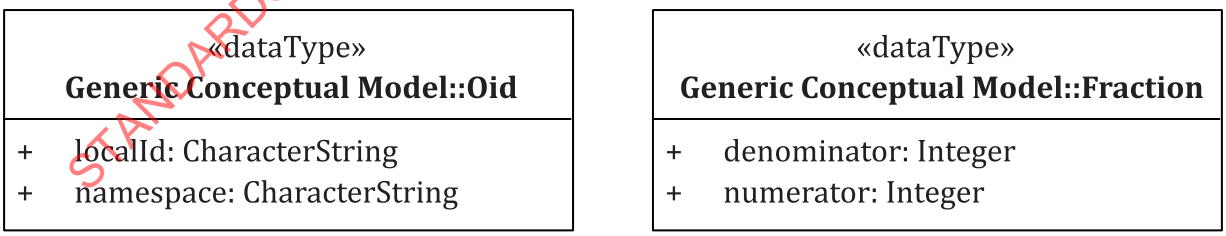

Figure 5 — Special data types

8.4.8.2 Oid

The data type Oid defines an object identifier that is structured as a local identifier and a name space. This data type is taken directly from ISO 19152-1.

This class takes on the following attributes and relations.

8.4.8.3 localId

This attribute comprises a character string that is unique within a namespace.

8.4.8.4 namespace

This attribute identifies the namespace in which the localId operates.

8.4.8.5 fraction

This attribute identifies a numeric datatype “fraction” that is not addressed in the primitive numeric types defined in ISO 19103. Fraction is expressed as a denominator and a numerator. Fraction is LADM-specific.

NOTE There are other ISO/TC 211 documents that have also defined "fraction" as a data type, although there is no consistency. In the basic types defined in ISO 19103, fraction is defined as a decimal fraction. There is a need in LADM to be able to define fractions that cannot be represented as decimal fractions, such as 1/3. For example, three parties can hold equal shares. The representation of 1/3 as a decimal fraction can potentially cause a roundoff error that would not represent equality for all parties while still adding up to 100 %.

This class takes on the following attributes and relations.

8.4.8.6 denominator

This is the denominator of a fraction expressed as an integer number. Integer is a primitive numeric type defined in ISO 19103.

8.4.8.7 numerator

This is the numerator of a fraction expressed as an integer number.

8.5 Administrative section

8.5.1 Administrative section general

The administrative section allows for the specification of RRR that can be associated to a BAUnit. This section corresponds to the Administrative package inherited from ISO 19152-1. In addition, the MG_Governance class has been included to allow for the description of the context information from a proclamation, law or treaty document.

The principle classes are MG_Rights, MG_Restrictions and MG_Responsibilities. These classes are subtypes of the abstract collection class MG_RRR. A co-dependence relationship allows for relations between instances of RRR.

The fundamental unit for administration is the BAUnit represented by the class MG_BAUnit. A BAUnit can take on multiple RRRs. An optional relationship is permitted between BAUnits that allows for different types of associates, such as grouping so that several BAUnits can be part of a larger unit, or peer relations so that a BAUnit can be associated with one or more others.

MG_BAUnit and MG_RRR uses different code lists and associations from the equivalent classes in ISO 19152-1. A realization relationship is therefore required.

NOTE If a subtyping relationship were used then the attributes and types would be inherited.

Figure 6 shows the general structure of the administrative section including the inheritance relationship from ISO 19152-1 through a set of realization relationships.

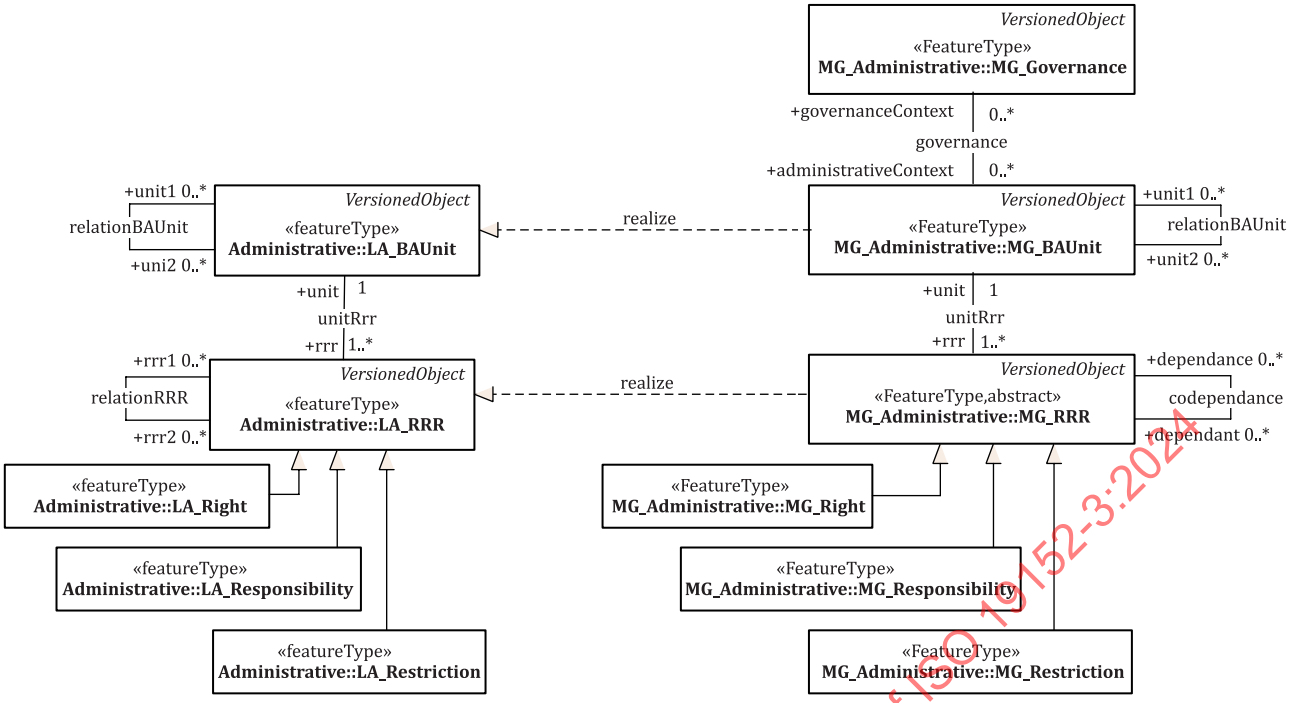

Figure 6 — Administrative section showing inheritance

Figure 7 shows the MG_Administrative section with attributes.

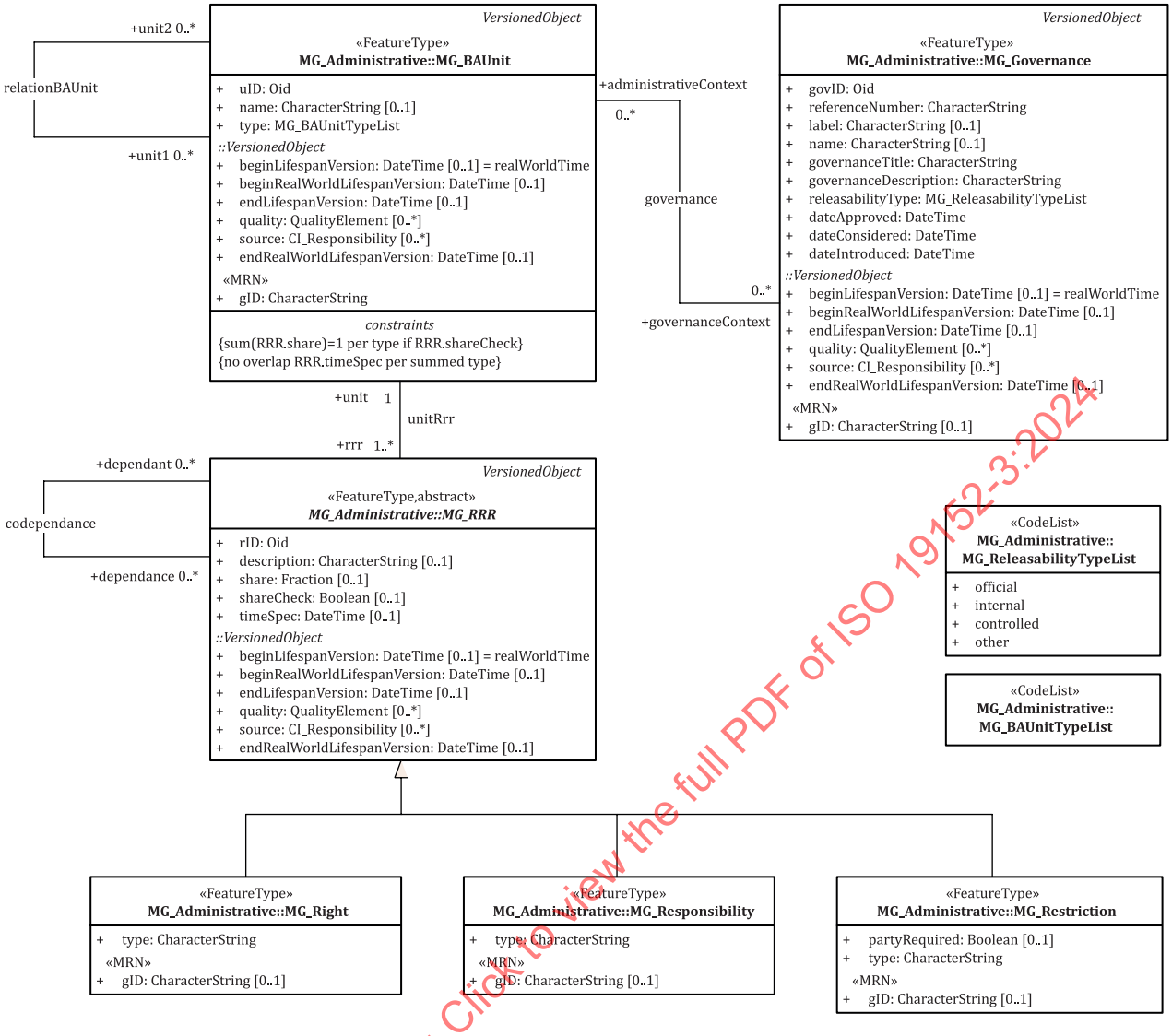

Figure 7 — Administrative section showing attributes

8.5.2 MG_BAUnit

A BAUnit is an administrative entity consisting of zero or more spatial units against which one or more unique and homogeneous rights (e.g. state sovereign right or innocent passage right), responsibilities or restrictions are associated to the whole entity, as included in a georegulation administration system. A BAUnit administrative entity is an information object since it does not directly take on spatial attributes.

8.5.3 MG_BAUnit attributes and relationships

8.5.3.1 uID

This attribute is the identifier of the BAUnit which allows reference to "MG_BAUnit" information objects using the "Oid" attribute type. The “Oid” comprises a unique character string and a namespace identifier which is also a unique character string.

8.5.3.2 name

This optional attribute specifies the name of the BAUnit.

8.5.3.3 type

This attribute specifies the type of the BAUnit from the code list MG_BAUnitTypeList. This code list is unique to the Marine georegulation domain.

8.5.3.4 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.5.3.5 relationBaunit relationship

This optional relationship relates instances of the object MG_BA_Unit to other instances of itself. This allows structures such as a group of MG_BAUnits being combined to form a composite unit or relations between MG_BAUnits at the same level. Navigation is undefined.

8.5.3.6 governance relationship

This is a relationship of governance information describing context information from a proclamation, law or treaty document to a set of administrative units represented by MG_BAUnits.

8.5.3.7 unitRrr relationship

Relationship of BAUnits represented by MG_BAUnits to one or more RRRs as represented by MG_RRR.

8.5.3.8 constraints

The following two constraints can optionally apply, as indicated by the boolean flag shareCheck in instances of MG_RRR:

{ no overlap RRR.timeSpec per summed type}

{ sum(RRR.share)=1 per type if RRR.shareCheck}

8.5.4 MG_BAUnitTypeList

The code list MG_BAUnitTypeList describes categories of type that can be established in the MG domain based on the BAUnit described in MG_BAUnit. This code list is unique to the MG domain. The code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include other releasability types.

Specific values for this code list are defined for the marine limits and boundaries domain established by S-121.[20] These are identified by the stereotype <MLB> for conformance class 1 and listed in Annex B.

8.5.5 MG_RRR

The MG_RRR class is an abstract collection class allowing for the definition of rights, restrictions or responsibilities or all. A subclass of LA_RRR is a "right" (or social tenure relationship), a "restriction", or a "responsibility". This class and its subtypes are realized from LA_RRR as defined in ISO 19152-1. The RRR objects are information objects that carry an object identifier "Oid". They can be referenced as objects from the attributes associated with a feature object. This allows "right", "responsibility" and "restrictions" to be re-used by several objects. That is, several objects can reference the same RRR objects. MG_RRR is an information object since it does not directly take on spatial attributes.

8.5.6 MG_RRR attributes and relationships

8.5.6.1 rID

This attribute is the identifier of the RRR (MG_RRR) collection class using the "Oid" attribute type. The "Oid" comprises a unique character string and a namespace identifier which is also a unique character string.

8.5.6.2 description

This optional attribute provides a description regarding the RRR.

8.5.6.3 share

This optional attribute specifies a share in an instance of a subclass of MG_RRR. This takes on the data type fraction.

8.5.6.4 shareCheck

This optional attribute specifies a boolean flag indicating whether the constraint is applicable. The constraint applies to the relation of MG_RRR elements to the MG_BAUnit. See 8.5.3.8.

8.5.6.5 timeSpec

This optional attribute specifies the operational use of a right with respect to time using the DateTime attribute data type. This can be used to express a fishing season or other time sensitive rights.

8.5.6.6 co-dependence relationship

The optional relationship describes a dependency relationship between a right, restriction or responsibility and another right, restriction or responsibility. For example, a right can require an associated responsibility. A right to lay an undersea cable can include a responsibility to maintain that cable and a responsibility for another (unspecified) party not to anchor or trawl in the vicinity.

8.5.7 MG_Right

The MG_Right class represents a "right" (or social tenure relationship). A right is an action, activity or class of actions that a system participant can perform on an associated resource or using an associated resource. This class is a subtype of MG_RRR and is realized from LA_Right. The MG_Right object is an information object that carries an object identifier "Oid". A "right" can be re-used by several feature objects. This object is realized from ISO 19152-1 because it takes on a character string type rather than a code list as an attribute. This is an information object since it does not directly take on spatial attributes.

8.5.8 MG_Right attributes and relationships

8.5.8.1 type

This attribute specifies the type of the right as a character string. Any type of right can be specified in accordance with the class of feature and the associated legal instrument. For example, a sovereign right can be established on an exclusive economic zone as defined under the UNCLOS.[27]

8.5.8.2 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.5.9 MG_Responsibility

The MG_Responsibility class represents a formal or informal obligation to do something. This class is a subtype of MG_RRR and is realized from LA_Responsibility. The MG_Responsibility object is an information object that carries an object identifier "Oid". A "responsibility" can be re-used by several feature objects. This object is derived from ISO 19152-1 using the UML realization relationship because it takes on a character string type rather than a code list as an attribute. This is an information object since it does not directly take on spatial attributes.

8.5.10 MG_Responsibility attributes and relationships

8.5.10.1 type

This attribute specifies the type of the responsibility as a character string. Any type of responsibility can be specified in accordance with the class of feature and the associated legal instrument. For example, a responsibility can exist to maintain an undersea cable over which a party has an ownership right.

8.5.10.2 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.5.11 MG_Restriction

The MG_Restriction class represents a formal or informal obligation to refrain from doing something. This class is a subtype of MG_RRR and is realized from LA_Restriction. The MG_Restriction object is an information object that carries an object identifier "Oid". A "restriction" can be re-used by several feature objects. This object is derived from ISO 19152-1 because it takes on a character string type rather than a code list as an attribute. This is an information object since it does not directly take on spatial attributes.

8.5.12 MG_Restriction attributes and relationships

8.5.12.1 partyRequired

This optional attribute specifies a boolean flag indicating whether a party is required for the registration of the restriction in the association to LA_Party.

8.5.12.2 type

This attribute specifies the type of the restriction as a character string. Any type of restriction can be specified in accordance with the class of feature and the associated legal instrument. For example, a restriction on navigation can exist in certain waters.

8.5.12.3 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing for marine space management. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.5.13 MG_Governance

The MG_Governance class represents a description of the context information from a proclamation, law or treaty document. Governance information defines title, reference number, date and other associated information linked to the particular proclamation, law and treaty documents to support the provision of specific description or interpretation that is applicable to the selected set of features. The MG_Governance object is an information object that carries an object since it does not directly take on spatial attributes. The MG_Governance class contains an explicit description of the information, which is different from the reference to external information contained in a source reference.

8.5.14 MG_Governance attributes and relationships

8.5.14.1 govID

This attribute is the identifier of the MG_Governance class using the "Oid" (Object ID) attribute type. The "Oid" comprises a unique character string and a namespace identifier which is also a unique character string.

8.5.14.2 referenceNumber

This attribute describes the reference number of the governance reference as a character string.

8.5.14.3 label

This optional attribute provides a short textual identifier of the governance object as a character string.

8.5.14.4 name

This optional attribute provides the name of the governance object as a character string.

8.5.14.5 governanceTitle

This attribute provides the title of the governance object as a character string.

8.5.14.6 governanceDescription

This attribute provides supporting information describing the governance statement as a character string.

8.5.14.7 releasabilityType

This attribute is used to differentiate between releasability status for governance information using the code list MG_ReleasabilityTypeList.

8.5.14.8 dateApproved

This attribute provides the date at which the statement or document was approved by the appropriate governing body using the DateTime attribute data type.

8.5.14.9 dateConsidered

This attribute provides the date at which the statement or document was considered by the appropriate governing body using the DateTime attribute data type.

8.5.14.10 dateIntroduced

This attribute provides the date at which the statement or document was introduced using the DateTime attribute data type.

8.5.14.11 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.6 Party to administrative section

The party and administrative sections are related through two relationships, the primary being the rrrParty relationship where a party is associated with a right, restriction or responsibility, and the other being the baunitAsParty relationship where an administrative unit can act as a party. This is shown in Figure 8.

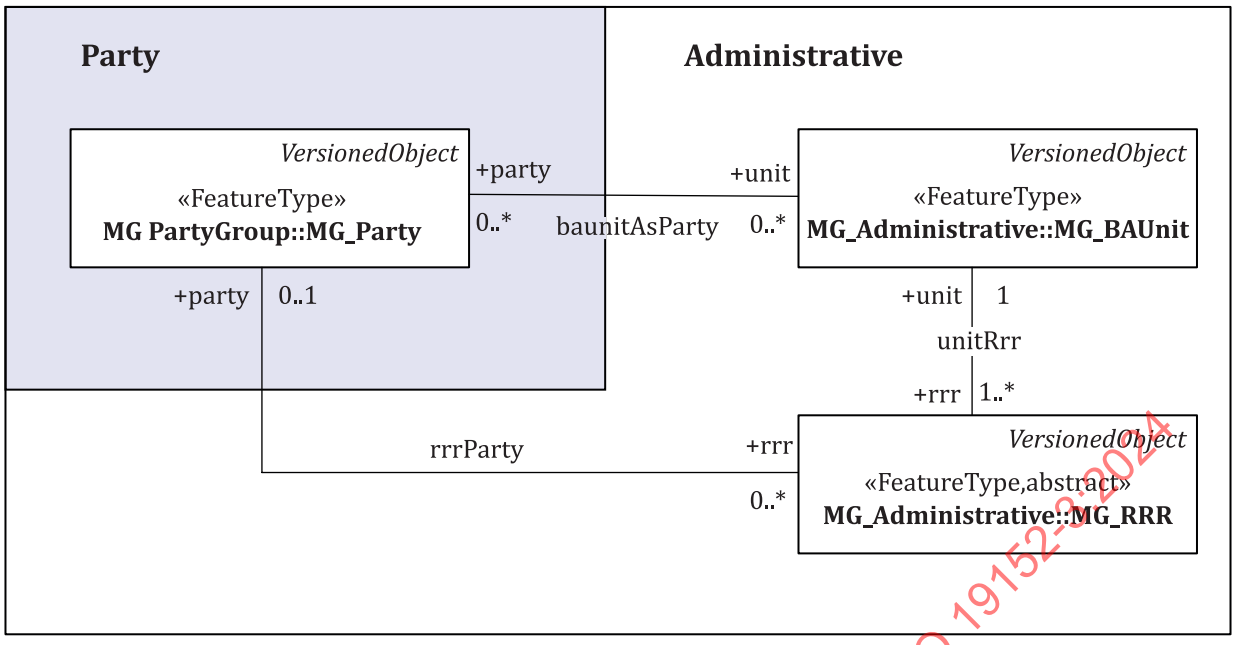

Figure 8 — Party to administrative relationship

8.7 Party to administrative relationships

8.7.1 rrrParty relationship

This is the relationship from MG_Party to an associated RRR in which the party participates.

8.7.2 baunitAsParty relationship

A BAUnit can in some situations act as a party. For example, a maritime marine zone can have certain rights associated with it under the UNCLOS.[27] The zone can act as the party with respect to that convention's assigned RRRs.

8.8 Spatial unit section

8.8.1 General

The spatial unit section relates administrative information (and any associated party information) to features which can carry spatial and thematic attributes. The ISO 19109 general feature model establishes the feature as the core element of geographic information. All geographic information described in the entire ISO/TC 211 suite of documents is feature-oriented. The general feature model defined in ISO 19109 indicates that a feature has properties which can be spatial, thematic or operational. In some parts of this document there is only one feature type involved, such as a real property. Many different types of features can be involved in the marine space and these can be of spatial type location, limit or boundary, zone, or space represented by the geometric primitives, point, curve, surface, or volume. The definition of the concept underlying each feature type, such as a marine boundary, is defined using a feature catalogue in accordance with ISO 19110. For example, a "territorial sea" is a feature of spatial type zone using surface geometry. The definition of a "territorial sea" is specified in the UNCLOS[27] and recorded in a feature catalogue maintained by the IHO in its geospatial registry. Other feature definitions for other feature types can be recorded in different feature catalogues and possibly recorded in different registries. All of the attributes, coded lists and code list values that can be associated to this feature type are also recorded in the feature catalogue. The register holding the feature catalogue elements is conformant with ISO 19135-1.

This document aligns with the general feature model and defines features as entities with spatial and thematic attributes. Although operations can be defined for features, this capability is not required here and any application schema that implements this document can extend the structure and add operations.

The administrative and party elements are termed information objects. In effect the administrative, party and source sections behave as indirect shared attributes by reference to the primary features defined in the feature/attribute spatial unit section. Information objects can have thematic attributes or properties. RRR and parties are administrative objects and are information objects that have no geographic spatial position.

Legal or official information can come from many sources. Often the binding legal agreements are historical and are defined in older coordinate reference systems (CRSs), or they can be defined in legal text. One coordinate is numeric on a historical CRS and the other is textual. It is necessary to be able to express this type of information using the standard.

Geographic information used in a geographic information system (GIS) is required to make use of a consistent CRS and have all of the geometry specified numerically. This can be done, but the resultant information would need to have been transformed from its original legal source. Both the source and transformed information needs to be supported by the standard.

The marine space application schema inherits the structures defined in ISO 19152-1 allowing a description of a spatial attribute textually called “location by text” and the description of a position in a CRS different from that used to describe other positions. For example, a limit can be described as an extension of a line, or a projection in a given direction. For a GIS to be able to calculate geometries, it is necessary for all the spatial attributes to be in the same CRS. However, the reference system in a judgment, treaty or law can be historic, derivative (such as calculation from an ambulatory baseline) qualitative or referential, without an absolute and fixed transformation to current global spatial systems.

The spatial unit section for the marine space is different from that used in other parts of the ISO 19152 series. It is in full alignment with the general feature model defined in ISO 19109, and the spatial schema defined in ISO 19107 and in the ISO 19136 series. It is also in full alignment with the spatial schema defined in S-100.[18] S-100 defines the Universal Hydrographic Model. This is derived directly from many of the ISO/TC 211 suite of standards, in particular the geometry, feature model, quality, metadata, coverage, portrayal and encoding specified across many of the ISO/TC 211 documents. Compatibility with S-100 is important because the IHO standards are widely used in the marine space, especially for standards supporting the UN conventions on the Law of the Sea (UNCLOS)[27] and the Safety of Life at Sea (SOLAS).[28] In particular, alignment with S-121[20] on maritime limits and boundaries is important. However, S-100 makes use of a subset of the capabilities allowed in ISO 19107. In particular the geometric types are restricted to point, multi-point (only for soundings), coverage (only for bathymetry and currents), curve (defined as a set of vertices and circular arc), surface and volume in 2 1/2 dimensions. That is, a volume is defined as a surface with a vertical extent specified using an attribute. These limitations on the available geometric primitives permit a planar graph topological constraint to be applied. This document accepts the S-100 constraints and is therefore compatible with both ISO 19107 and S-100. It is simple to convert to and from the expression of survey geometry described in other parts of this document, but they are not identical structures.

The MG_FeatureUnit has two components, the MG_SpatialAttributeType and the MG_AdditionalSpatialInformationType. The MG_FeatureUnit can take on attributes in the same manner as any other feature defined in accordance with the general feature model of ISO 19109. In addition, the spatial attributes can be of two types. The MG_SpatialAttributeType allows conventional geometric attributes, while MG_AdditionalSpatialInformationType allows for additional spatial attributes such as location by text or positions in other (historical) CRSs.

Figure 9 shows the feature/attribute spatial unit structure with inheritance.

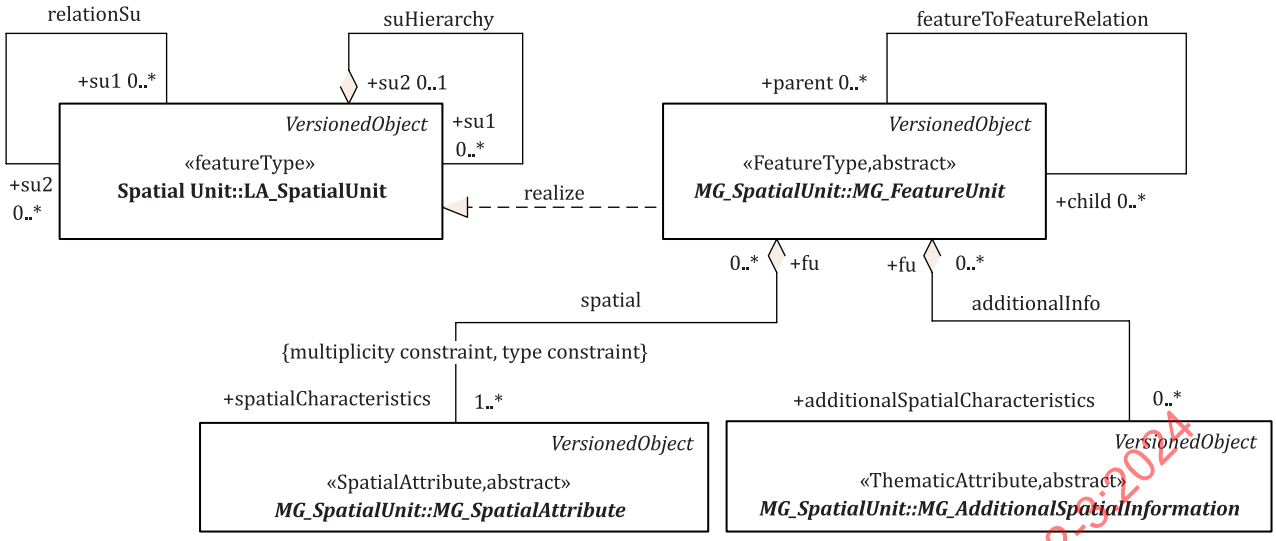

Figure 9 — Feature/attribute spatial unit section

Figure 10 shows the spatial unit section with attributes and constraints.

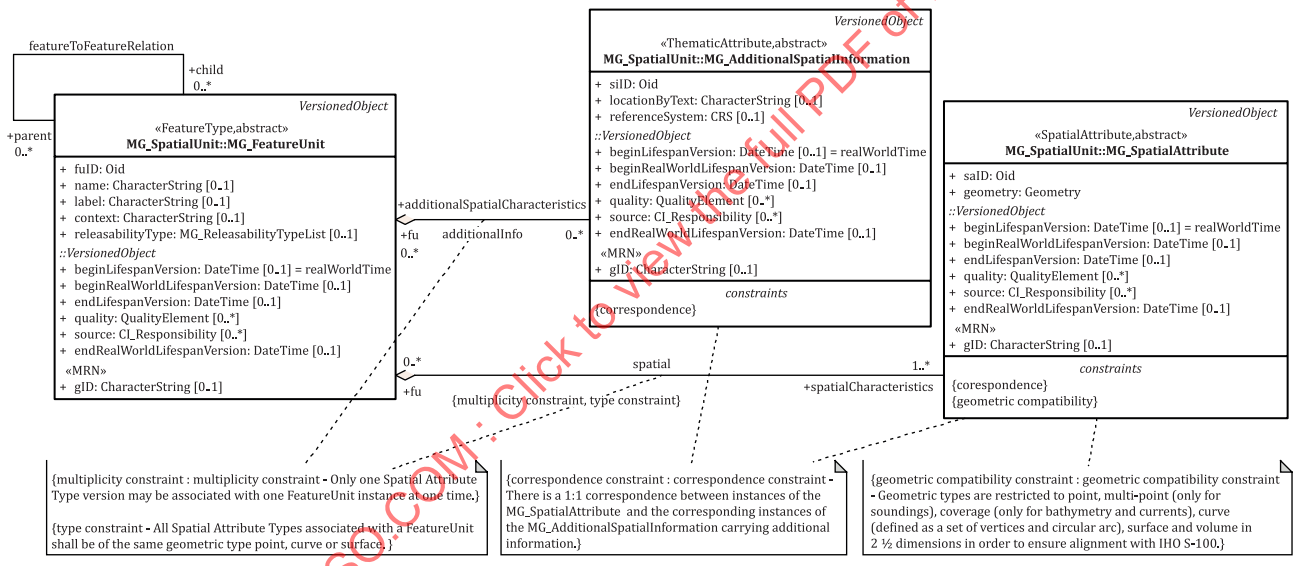

Figure 10 — Feature/attribute spatial unit section showing attributes

8.8.2 MG_FeatureUnit

A feature unit is an object that represents an abstraction of a real world phenomenon. Each type of feature unit has a definition that is described in a feature catalogue, and takes on spatial and thematic attributes. A feature unit is derived from ISO 19101-1 and the general feature model of ISO 19109 and the S-100[18] general feature model and takes on spatial attributes through a relation to the class MG_SpatialAttribute. MG_FeatureUnit is an abstract class. It is implemented through its subtypes "Location", "Limit", "Zone", "Space".

8.8.3 MG_FeatureUnit attributes and relationships

8.8.3.1 fuID

This attribute is the identifier of the feature unit using the "Oid" attribute. The "Oid" comprises a unique character string and a namespace identifier which is also a unique character string.

8.8.3.2 name

This optional attribute specifies the name of the feature unit.

8.8.3.3 label

This optional attribute provides a short textual identifier of the feature unit as a character string.

8.8.3.4 context

This optional attribute describes the administrative context of the feature object as a character string.

8.8.3.5 releasabilityType

This attribute is optionally used to differentiate between releasability status for particular features using the code list MG_ReleasabilityTypeList.

8.8.3.6 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. This attribute provides a global unique identifier to be used at the implementation level. It parallels all of the other IDs that each have their own namespaces. This ID can be whatever the GIS system supporting the data requires. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.8.3.7 featureToFeatureRelation relationship

The optional featureToFeatureRelation relationship relates instances of the object MG_FeatureUnit to other instances of itself. This allows structures such as a hierarchical group of MG_FeatureUnits to be combined to form a composite unit. Navigation is undefined.

8.8.4 MG_SpatialAttribute

This abstract spatial attribute class is a linkage to the spatial subtypes "Point", "Curve", "Surface", and "Volume". It is implemented through its subtypes. This class supports a deliberate subset of the geometry types available in ISO 19107 in order to be compatible with S-100.[18] This allows for simpler and more easily testable implementations.

8.8.5 MG_SpatialAttribute attributes and relationships

8.8.5.1 saID

This attribute is the identifier is the identifier of the MG_SpatialAttribute class using the "Oid" attribute. The "Oid" comprises a unique character string and a namespace identifier which is also a unique character string. It is an abstract group ID that is further resolved into individual IDs for MG_Point, MG-Curve, MG-Surface and MG-Volume corresponding to "Location", "Limit", "Zone" and "Volume".

8.8.5.2 geometry

This spatial attribute identifies the geometric primitive, as defined in ISO 19107. Only the geometric primitives point, curve, arcByCentrePoint and circleByCentrePoint, and surface are used. Volume is constructed out of the surface with a vertical extent attribute. This attribute makes a generic reference to GM_Object from ISO 19107. If building a profile of the model presented in this document (ISO 19152-3) then any geometry allowed in ISO 19107 can be used as a subtype to this abstract class. However, alignment with S-100[18] will only be maintained by alignment with the geometric compatibility constraint. This attribute can be overwritten by a particular type of spatial primitive in a subtype.

8.8.5.3 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. This attribute provides a global unique identifier to be used at the implementation level. It parallels all of the other IDs that each have their own namespaces. This ID can be whatever the GIS system supporting the data requires. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.8.5.4 geometric compatibility constraint

Geometric types are restricted to point, multi-point (only for soundings), coverage (only for bathymetry and currents), curve (defined as a set of vertices and circular arc), surface and volume in 2 1/2 dimensions in order to ensure alignment with S-100.[18]

8.8.5.5 correspondence constraint

There is a 1:1 correspondence between instances of MG_SpatialAttribute and the corresponding instances of the MG_AdditionalSpatialInformation carrying additional information.

8.8.5.6 spatial relationship

The spatial relationship is an aggregation relationship of a feature unit as represented by MG_FeatureUnit to one or more spatial attributes described by MG_SpatialAttribute, that define its location and geometric shape.

8.8.5.7 multiplicity constraint

The multiplicity constraint is applicable on the spatial relationship. Only one spatial attribute type version can be associated with one FeatureUnit instance at one time.

8.8.5.8 type constraint

The type constraint applies on the spatial relationship. All spatial attribute types associated with a FeatureUnit are of the same geometric type point, curve or surface.

8.8.6 MG_AdditionalSpatialInformation

This abstract class provides additional spatial information. It allows for spatial attributes such as "Location by Text" that do not participate in the geometry of the geographic information system (or GIS database). This supports "S100_GF_ThematicAttributeType". This allows for the description of the attribute "Location by Text" or a position or both in a unique CRS, i.e. additional locations in other historical CRSs or textual descriptions can be used. For example, a historical CRS can be defined in the text of a treaty (and is therefore the "legal" text), even though it would need to be translated to a different coordinate reference system to be used with other data.

8.8.7 MG_AdditionalSpatialInformation attributes and relationships

8.8.7.1 siID

This attribute is the identifier of the MG_AdditionalSpatialInformation class using the "Oid" attribute. The "Oid" comprises a unique character string and a namespace identifier which is also a unique character string. It is an abstract group ID that is further resolved into individual IDs for MG_PointAttributes, MG_CurveAttributes, MG_SurfaceAttributes and MG_VolumeAttributes corresponding to "Location", "Limit", "Zone" and "Volume".

8.8.7.2 locationByText

The attribute locationByText allows a spatial attribute to be a textual description. This allows "Location", "Limit", "Zone" and "Space" that are not fully described geometrically to be included.

8.8.7.3 referenceSystem

The attribute "ReferenceSystem" allows a CoordinateReferencingSystem (CRS) to optionally be specified at the "spatialAttributeTypeList" level. In many other geographic information products, the CRS is only defined at the metadata level and applies for the whole data set. However, within the context of this document it is necessary to define it right down to the specific instances of geometry, since points and lines can come from different sources such as different treaties that can use different a CRS. The conceptual schema for the description of referencing by coordinates is described in ISO 19111.

8.8.7.4 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. This attribute provides a global unique identifier to be used at the implementation level. It parallels all of the other IDs that each have their own namespaces. This ID can be whatever the GIS system supporting the data requires. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.8.7.5 correspondence constraint

There is a 1:1 correspondence between instances of MG_AdcditionalSpatialAttribute and the corresponding instances of the MG_AdditionalSpatialInformation carrying additional information.

8.8.7.6 additionalInfo relationship

This is the aggregation relationship of a feature unit as represented by MG_FeatureUnit to one or additional thematic information related to location or spatial geometry. This allows for the description of the attribute "Location by Text" or a position or both in a unique CRS, that does not participate directly in the spatial geometry.

8.8.7.7 multiplicity constraint

The multiplicity constraint applies on the additionalInfo relationship. Only one spatial attribute type version can be associated with one FeatureUnit instance at one time.

8.8.7.8 type constraint

The type constraint applies on the additionalInfo relationship. All spatial attribute types associated with a FeatureUnit are of the same geometric type point, curve or surface.

Figure 11 shows the feature/attribute spatial unit elements that instantiate the abstract MG_FeatureUnit, MG_SpatialAttribute and MG_AdditionalSpatialInformation classes.

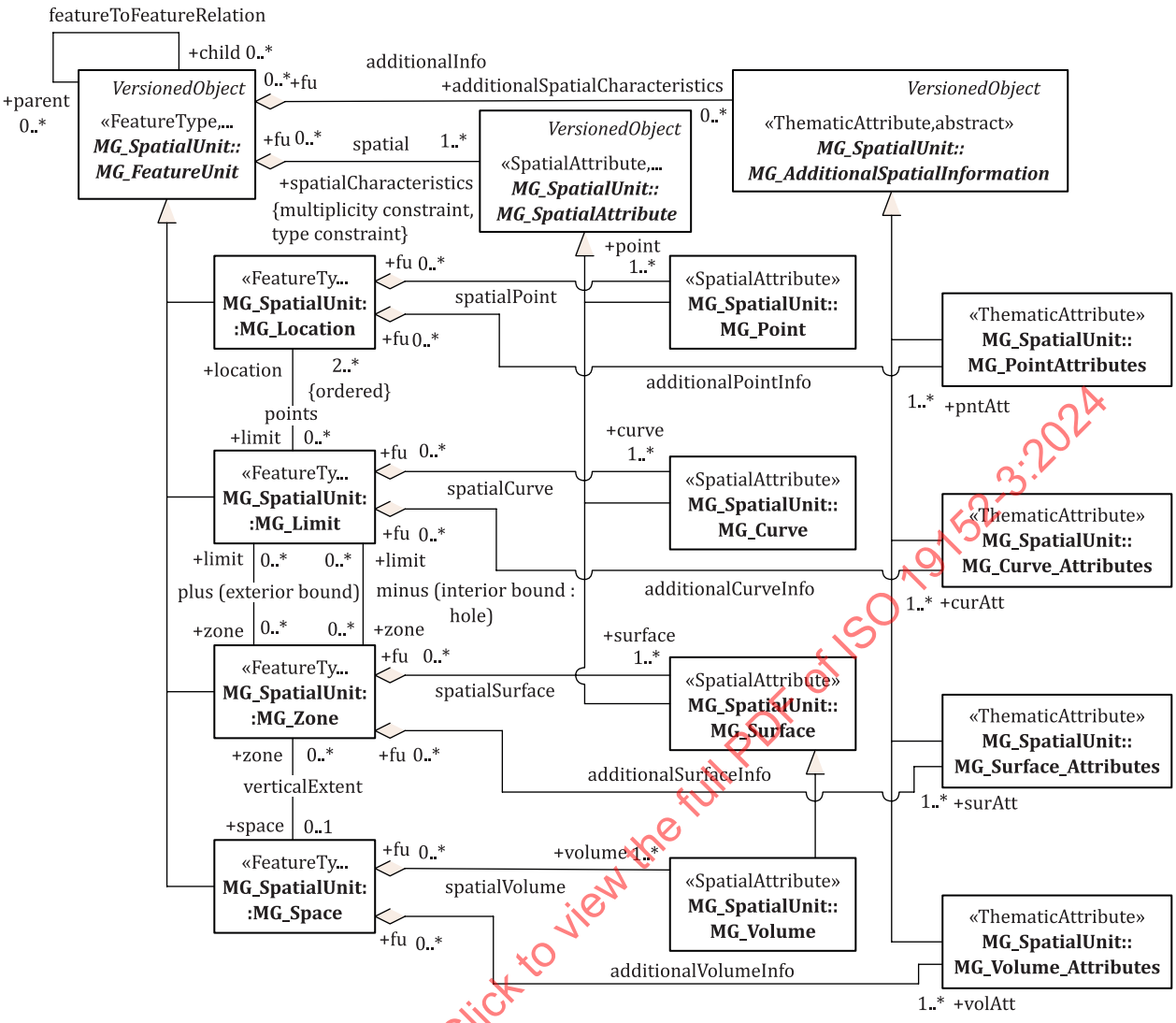

Figure 11 — Feature/attribute spatial unit elements

Figure 12 shows the MG_Location spatial unit class with its components.

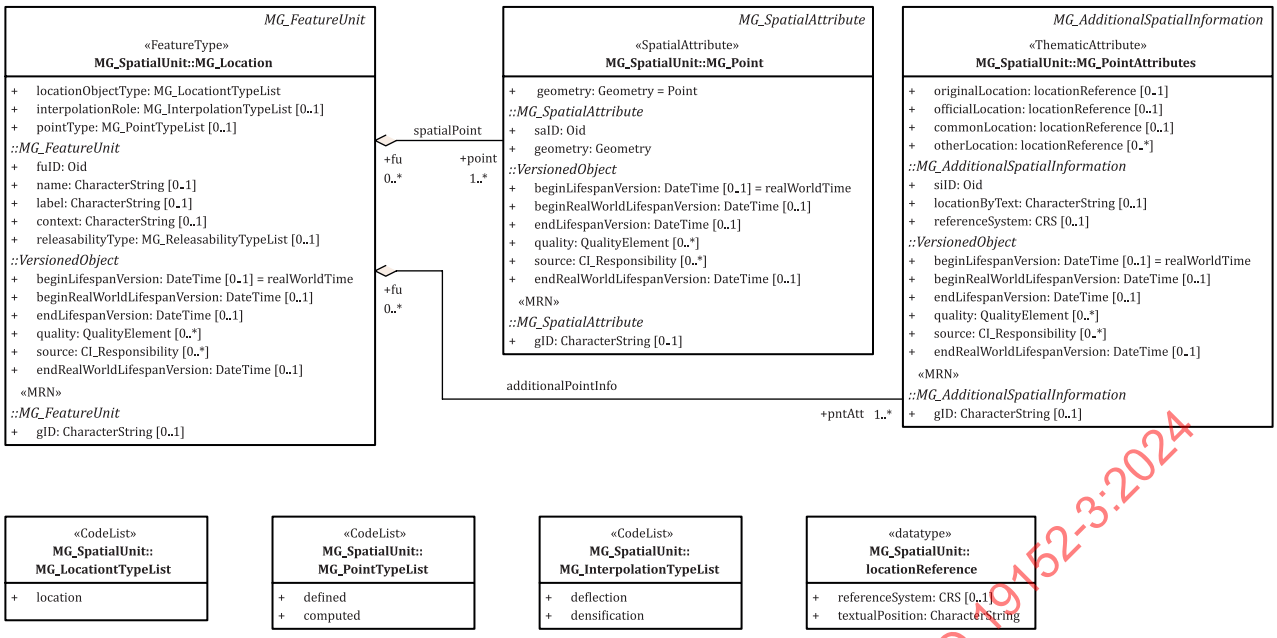

Figure 12 — Location spatial geometry

8.8.8 MG_Location

A feature unit that takes on point spatial geometry.

8.8.9 MG_Location attributes and relationships

8.8.9.1 locationObjectType

This attribute identifies which feature unit location object type this object refers to, based on the code list MG_LocationTypeList. This allows a description of whether a particular point is a turning point along a line or a point included to densify a line to ensure the geometry of a feature is correctly represented. The code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include all aspects of the legal context.

8.8.9.2 interpolationRole

This attribute defines the role of a point in the structure of a "Straight" line or curve. The code list MG_InterpolationTypeList plays the same role as the code list LA_InterpolationType but is modified to suit the marine space georegulation environment, especially maritime limits and boundaries. The code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include all aspects of the legal context.

8.8.9.3 pointType

This attribute defines how the point was created. The code list MG_PointTypeList plays the same role as the code list LA_PointType but is modified to suit the marine space georegulation environment, especially marine limits and boundaries. The code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include all aspects of the legal context.

8.8.9.4 spatialPoint relationship

This is the aggregation relationship of a feature unit as represented by MG_FeatureUnit to one or more spatial attributes that define the location of a point. The relationship only supports the geometry type "Point".

8.8.9.5 additionalPointInfo relationship

This is the aggregation relationship of a location feature unit as represented by MG_Location to additional thematic information related to location/point spatial geometry. This allows for the description of the attribute "Location by Text" or a position (point/location) or both in a unique CRS that does not participate directly in the spatial geometry.

8.8.10 MG_Point

This component describes a spatial attribute that takes on point spatial geometry. It provides point spatial geometry for a feature unit in a consistent CRS. MG_Point spatial attributes have a consistent geometric description and CRS and can participate in a geometric complex. This component can be processed in a GIS.

8.8.11 MG_Point attributes and relationships

8.8.11.1 geometry

This spatial attribute identifies the geometric primitive to be GM_Point. This spatial attribute overwrites the attribute geometry in the abstract class MG_SpatialAttribute with the value "GM_Point", identifying point geometry as defined in ISO 19107 Spatial Schema.

NOTE The class GM_Point is simply called "Point" in the latest edition of ISO 19107, but S-100[18] is compatible with both the newest and the older versions of ISO 19107, so the prefix GM is retained. This is also true for the other primitive geometry classes defined in ISO 19107 where the prefix GM is retained.

8.8.12 MG_PointAttributes

This component describes additional spatial information that augments point spatial geometry. The additional information can use a different CRS or it can be a textual description. Therefore, it does not necessarily have a consistent geometric description and it can be unsuitable for participation in a geometric complex or for being processed geometrically in a GIS system without transformation.

8.8.13 MG_PointAttributes attributes and relationships

8.8.13.1 originalLocation

This optional attribute defines the reference location of a point when it was first established. This includes a description of the point as a textual string, so that the exact representation of the point can be maintained in terms of degrees and decimal degrees, or degrees, minutes and seconds, or other descriptions. In the case of the original location, this can be a description of meets and bounds or whatever is included in the treaty or other original document. A CRS should be included where available. Often a CRS is not available for original locations derived from some treaties and instruments.

8.8.13.2 officialLocation

This attribute describes the official reference of the point. This is the legal description of the point in a textual form, so that the exact representation of the point can be maintained in terms of degrees and decimal degrees, or degrees, minutes and seconds, or other descriptions. A reference system (CRS) is optional but should be included where available. A CRS is logically required to be described somewhere for all geographic location information, but in some circumstances it is only included in the base legal text and therefore can only be included by reference through a source object.

8.8.13.3 commonLocation

This optional attribute describes the common reference location of a point in a datum that is defaulted to the other points in the dataset.

8.8.13.4 otherLocation

This optional attribute defines any other point reference location. There can be several other locations in different reference systems.

8.8.14 locationReference dataType

This data type describes a point location. A point location is described as a string of text, even if it is numeric data, in exactly the same way that it is described in the source legal document. A reference system can be associated, although it is not necessarily available and can need to be inferred from the source document.

8.8.15 MG_PointAttributes attributes

8.8.15.1 referenceSystem

The attribute "referenceSystem" allows a CoordinateReferencingSystem (CRS) to optionally be specified at the "MG_AdditionalSpatialInformation" level. In many other geospatial data products, the CRS is only defined at the metadata level and applies for the whole data set. However, in this document it is necessary to define it down to the specific instances of geometry, since treaty points and lines can come from different sources such as different treaties that can use a different CRS.

EXAMPLE The UN DOALOS[29] requests the use of the WGS84 CRS for deposit.

8.8.15.2 textualPosition

This attribute defines a point coordinate value in a textual format, in exactly the same way that it is described in the source legal document.

8.8.16 MG_LocationTypeList

The code list MG_LocationTypeList describes categories of "LocationType" that have a common characteristic related to the legal and administrative aspects of the marine environment. To extend beyond the list of location types given in this code list the generic "location" type can be used. This code list can also be registered in a feature concept dictionary as listed values and as such can be expanded to include all aspects of the legal context. National systems can also extend this code list within their own contexts.

Specific values for this code list are defined for the maritime limits and boundaries domain established by S-121.[20] These are identified by the stereotype <MLB> for conformance class 1 and listed in Annex B.

This code list takes on the following value:

— **location** — a generic geographic position represented by a point.

8.8.17 MG_PointTypeList

The code list MG_PointTypeList describes how the point was created. The code list MG_PointTypeList plays the same role as the code list LA_PointType but is modified to suit the marine georegulation environment, especially maritime limits and boundaries. National systems can also extend this code list within their own contexts.

This code list takes on the following values:

— **defined** — a location that is derived from a legislative document or other definitive sources;

— **computed** — a location that is computed in accordance with the definition described in the source through proper geodetic calculations. For example, the intersection of two arcs over an ellipsoidal surface. A point can be established to support construction computations.

8.8.18 MG_ InterpolationTypeList

The code list MG_InterpolationTypeList describes how a point is used in a line or curve structure. The code list MG_InterpolationTypeList plays the same role as the code list LA_InterpolationType but is modified to suit the marine space georegulation environment, especially maritime limits and boundaries. National systems can also extend this code list within their own contexts.

This code list takes on the following values:

— **deflection** — a turning point along a line;

— **densification** — a location that densifies a line to ensure the geometry of a feature is correctly represented

8.8.19 MG_Limit Spatial Unit Class

Figure 13 shows the MG_Limit spatial unit class with its components.

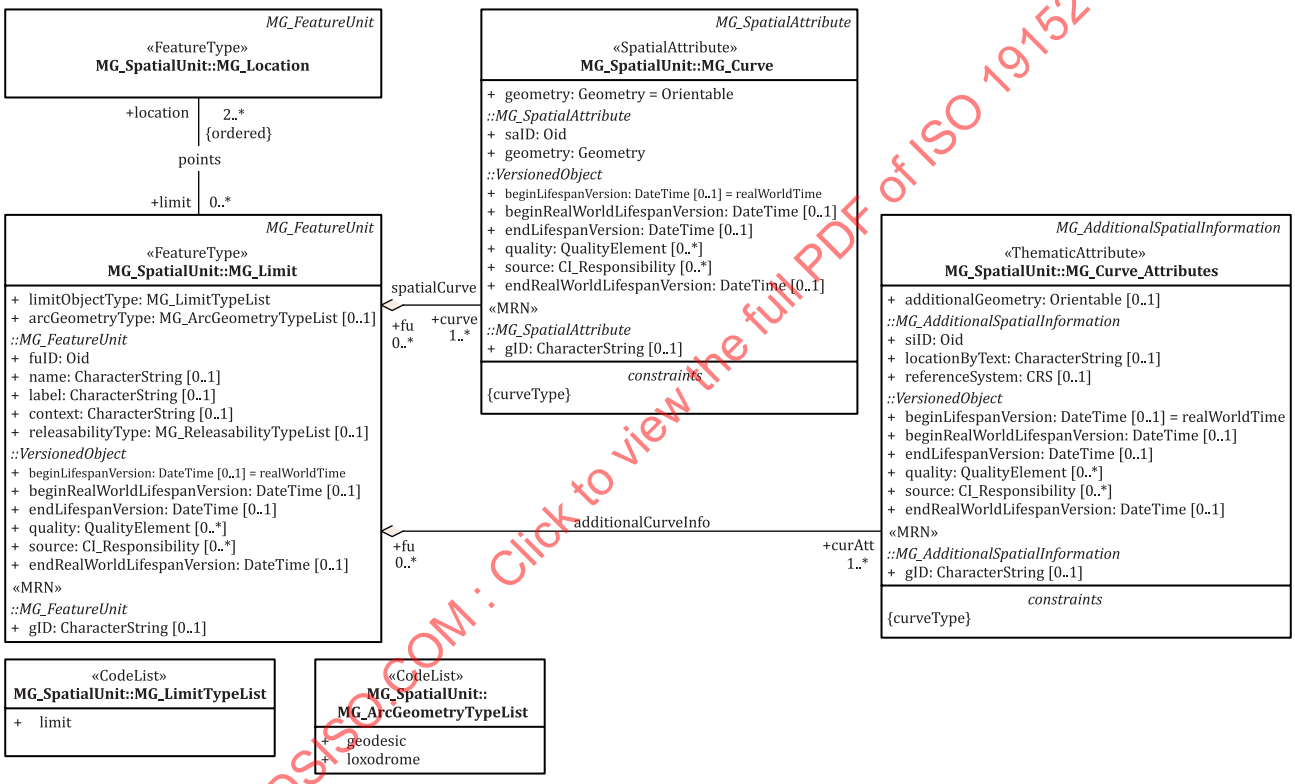

Figure 13 — Limit spatial geometry

8.8.20 MG_Limit

A feature unit that takes on curve spatial geometry can be used to define limits or boundaries. A limit is an object that defines a curve which is logically delimited by instances of "MG_Location".

8.8.21 MG_Limit attributes and relationships

8.8.21.1 limitObjectType

This attribute identifies which feature unit LimitObject type this object refers to, based on the code list "MG_LimitTypeList".

8.8.21.2 arcGeometryType

This optional attribute identifies the type of computation used to define an arc (line) based on the code list "MG_ArcGeometryTypeList".

8.8.21.3 Points relationship

This relation identifies the relationship between MG_Location spatial units and MG_Limit spatial unit. An MG_Limit spatial unit is bounded at each end by an MG_Location spatial unit. That is, logically there are defined MG_Locations at each end of an MG_Limit. The locations are ordered, corresponding to the start and end of the limit.

8.8.21.4 spatialCurve relationship

This is the aggregation relationship of a feature unit as represented by MG_FeatureUnit to one or more spatial attributes that define the location and geometric shape of a curve specified by a set of vertices or as a circular arc.

8.8.21.5 additionalCurveInfo relationship

This is the aggregation relationship of a feature unit as represented by MG_FeatureUnit to additional thematic information related to curve spatial geometry. This allows for the description of the attribute "Location by Text" or a description of a curve/limit or both in a unique CRS that does not participate directly in the spatial geometry.

8.8.22 MG_Curve

This component describes a spatial attribute that takes on curve spatial geometry. It provides curve spatial geometry for a feature unit in a consistent coordinate reference system. Curves can only be specified by a set of vertices or as a circular arc "arcByCentrePoint" and "circleByCentrePoint". MG_Curve spatial attributes have a consistent geometric description and coordinate reference system and can participate in a geometric complex. It component can be processed in a GIS.

8.8.23 MG_Curve attributes and constraints

8.8.23.1 geometry

This spatial attribute identifies the geometric primitive to be GM_OrientableCurve. This spatial attribute overwrites the attribute geometry in the abstract class MG_SpatialAttribute with the value "GM_OrientableCurve", identifying curve geometry as defined in ISO 19107.

8.8.23.2 curveType constraint

The curveType constraint applies on the additionalCurveInfo relationship. Curve spatial primitives are limited to GM_OrientableCurve and GM_Curve (arcByCentrePoint and circleByCentrePoint). This aligns with S-100 Part 7.[18]

8.8.24 MG_Curve_Attributes

This component describes additional spatial information that augments curve spatial geometry. The additional information can use a different CRS or it can be a textual description. Therefore, it does not necessarily have a consistent geometric description and it can be unsuitable for participation in a geometric complex, or for being processed geometrically in a GIS without transformation.

8.8.25 MG_Curve_Attributes attributes and constraints

8.8.25.1 additionalGeometry

This spatial attribute identifies an additional curve geometric primitive in the form of a GM_OrientableCurve. This curve takes on the CRS defined in the attribute “referenceSystem” inherited from MG_AdditionalSpatialInformation. This permits a curve to be optionally defined in a different CRS from that defined for other data in the data set. For example, this can come from a treaty or other historical source. It also allows a consistent curve geometry.

8.8.25.2 curveType constraint

Curve spatial primitives are limited to GM_OrientableCurve and GM_Curve (arcByCentrePoint and circleByCentrePoint). This aligns with S-100.[18] See 8.8.23.2.

8.8.26 MG_ArcGeometryTypeList

The code list MG_ArcGeometryTypeList describes the category of lines or arcs that can be represented on the surface of the ellipsoid. National systems can also extend this code list within their own contexts.

This code list takes on the following values:

— **geodesic** — a curve which describes a path of shortest distance along the surface of an ellipsoid, namely a segment of a great circle;

— **loxodrome** — a curve which describes an arc crossing all meridians of longitude at the same angle; a path with constant bearing.

8.8.27 MG_LimitTypeList

The code list MG_LimitTypeList describes categories of "limitType" that have a common characteristic related to the legal and administrative aspects of the marine environment. To extend beyond the list of limit types given in this code list, the generic "limit" type can be used. The code list can also be registered in a feature concept dictionary as listed values and as such can be expanded to include other aspects of the legal context. National systems can also extend this code list within their own contexts.

Specific values for this code list are defined for the maritime limits and boundaries domain established by S-121.[20] These are identified by the stereotype <MLB> for conformance class 1 and listed in Annex B.

This code list takes on the following value:

— **limit** — a curve that defines a boundary or extent of a zone.

8.8.28 MG_Zone Spatial Unit Class

Figure 14 shows the MG_Zone spatial unit class with its components.

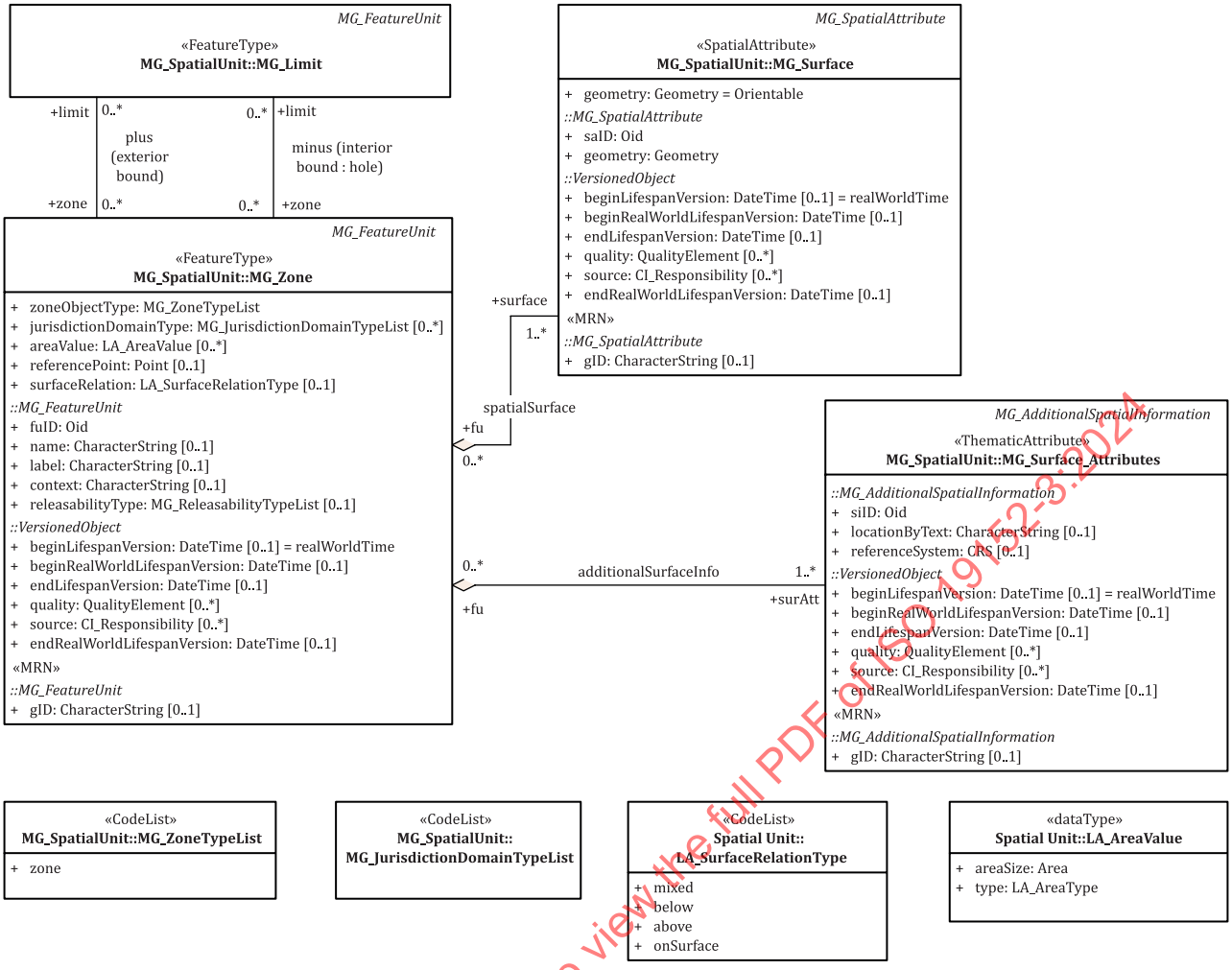

Figure 14 — Zone spatial geometry

8.8.29 MG_Zone

A feature unit that takes on surface spatial geometry can be used to define areas or zones. A zone is an object that defines an area which is logically delimited by instances of "MG_Limit".

8.8.30 MG_Zone attributes and relationships

8.8.30.1 zoneObjectType

This attribute identifies the feature unit ZoneObject type to which this object refers, based on the code list "MG_ZoneTypeList".

8.8.30.2 jurisdictionDomainType

This optional attribute defines the juridical domain of the object delimited, based on the code list "MG_ JurisdictionDomainTypeList".

8.8.30.3 areaValue

This optional attribute identifies the area of the zone. This attribute makes use of the class LA_AreaValue from ISO 19152-2.

8.8.30.4 referencePoint

This optional attribute identifies the coordinates of a point inside the zone spatial unit.

8.8.30.5 surfaceRelation

This optional attribute identifies the relationship to the surface based on the code list "LA_SurfaceRelationType".

8.8.30.6 plus relationship

This relationship between MG_Zone spatial unit and MG_Limit spatial units describes an inner bound or hole. A hole or exclusion in an MG_Zone spatial unit is bounded by a set of inner (minus) MG_Limit spatial units. The aggregation of limits to form an inner bound of the hole in the zone follows the rules of GM_OrientableCurve as defined in ISO 19107.

8.8.30.7 minus relationship

This is the aggregation relationship of a feature unit as represented by MG_FeatureUnit to one or more spatial attributes that define the location and geometric shape of a surface (also known as an area).

8.8.30.8 spatialSurface relationship

This is the aggregation relationship of a feature unit as represented by MG_FeatureUnit to one or more spatial attributes that define the location and geometric shape of a surface (also known as an area).

8.8.30.9 additionalSurfaceInfo relationship

This is the aggregation relationship of a feature unit as represented by MG_FeatureUnit to additional thematic information related to surface spatial geometry. This allows for the description of the attribute "Location by Text" or a description of a surface/zone or both in a unique CRS that does not participate directly in the spatial geometry.

8.8.31 MG_Surface

This component describes a spatial attribute that takes on surface spatial geometry. It provides surface spatial geometry for a feature unit in a consistent coordinate reference system. Surfaces are bounded by curves. MG_Surface spatial attributes have a consistent geometric description and CRS and can participate in a geometric complex. This component can be processed in a GIS.

8.8.32 MG_Surface attributes

8.8.32.1 geometry

This spatial attribute identifies the geometric primitive to be GM_OrientableSurface. This spatial attribute overwrites the attribute geometry in the abstract class MG_SpatialAttribute with the value "GM_OrientableSurface", identifying surface geometry as defined in ISO 19107.

8.8.33 MG_Surface_Attributes

This component describes additional spatial information that augments surface spatial geometry. The additional information can use a different CRS or it can be a textual description. Therefore, it does not necessarily have a consistent geometric description and it can be unsuitable for participation in a geometric complex, or for being processed geometrically in a GIS without transformation. The attributes identifying the additional information inherit from “MG_AdditionalSpatialInformation”.

8.8.34 MG_ZoneTypeList

The code list MG_ZoneTypeList describes categories that have a common characteristic related to the legal and administrative aspects of the marine environment. To extend beyond the list of zone types given in this code list, the generic "zone" type can be used. The code list can also be registered in a feature concept dictionary as listed values and as such can be expanded to include all aspects of the legal context. National systems can also extend this code list within their own contexts.

Specific values for this code list are defined for the maritime limits and boundaries domain established by S-121.[20] These are identified by the stereotype <MLB> for conformance class 1 and listed in Annex B.

This code list takes on the following value:

— **zone** — a surface (area) which has a particular characteristic which is logically delimited by instances of "Limit".

8.8.35 MG_JurisdictionDomainTypeList

The code list MG_JurisdictionDomainTypeList defines the juridical domain of the object delimited. Any particular feature unit object can span more than one jurisdiction domain. To extend the list beyond the types given, the code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include additional jurisdictional domain types.

Specific values for this code list are defined for the maritime limits and boundaries domain established by S-121.[20] These are identified by the stereotype <MLB> for conformance class 1 and listed in Annex B. More complex juridical interactions can occur in different contexts. National systems can also extend this code list within their own contexts.

8.8.36 LA_SurfaceRelationType

The code list LA_SurfaceRelationType defines the spatial relationship of a feature unit to other feature units.

The description of this code list is provided in ISO 19152-1.

8.8.37 LA_AreaType

The code list LA_AreaType defines the jurisdictional status of a feature unit.

The description of this code list is provided in ISO 19152-1.

8.8.38 LA_AreaValue

The datatype LA_AreaValue describes the size of a feature unit and makes reference to its type.

The description of this code list is provided in ISO 19152-2.

8.8.39 MG_Space spatial unit class

Figure 15 shows the MG_Space spatial unit class with its components.

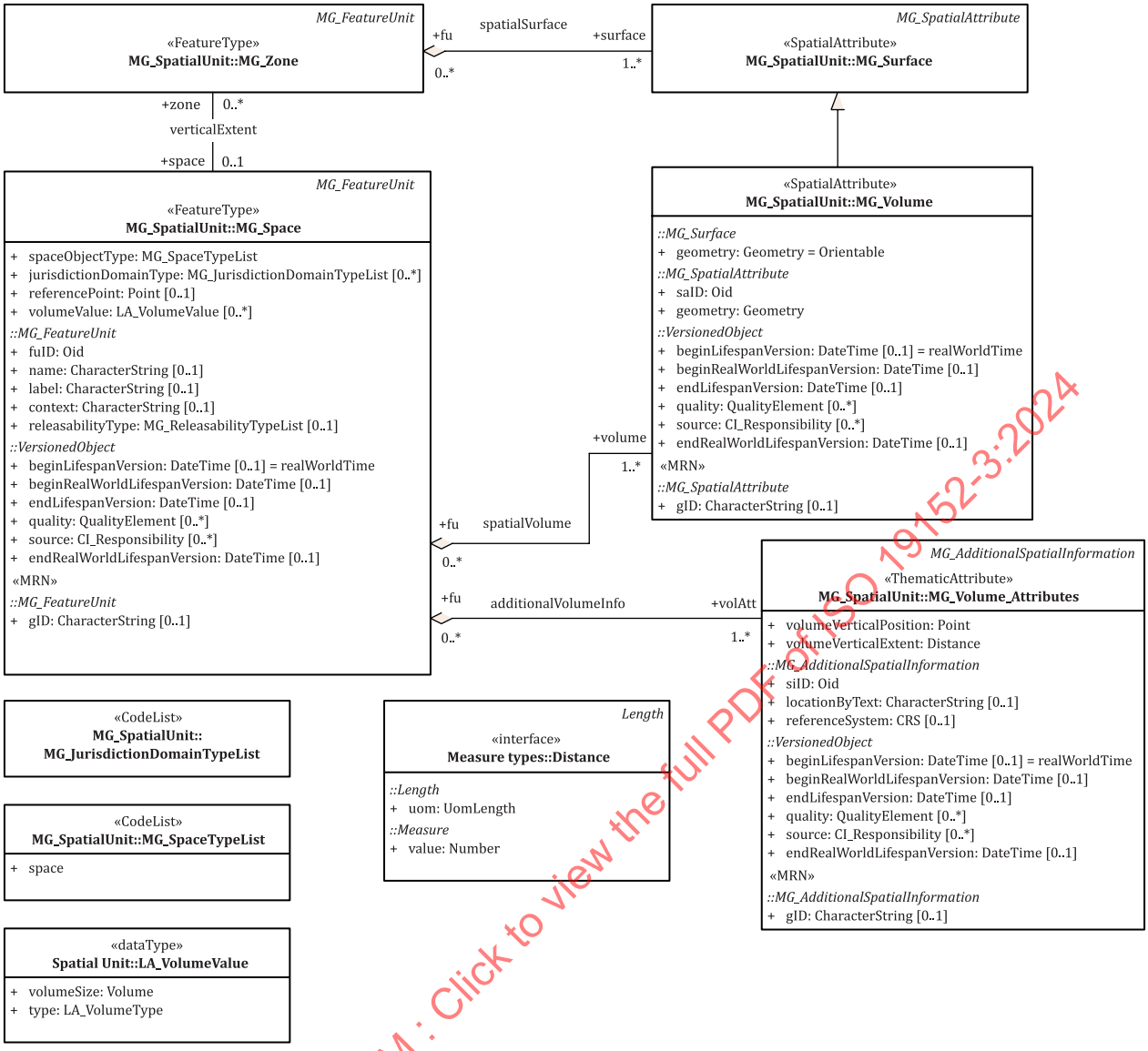

Figure 15 — Space spatial geometry

8.8.40 MG_Space

This is a feature unit that takes on volume spatial geometry. MG_Space is an object that defines a volume which is logically delimited by instances of "Zone".

A "Space" is an object of 2 dimensions with a height description located in 2 or 3 dimensional "Space". This is sometimes called 2 1/2 dimensions. A "Space" has the same geometry as a "Zone" with the attributes of vertical position. The vertical position can be explicit numerical attributes of height above a reference or a textual description.

8.8.41 MG_Space attributes and relationships

8.8.41.1 spaceObjectType

This attribute identifies the feature unit space type to which this object refers, based on the code list "MG_SpaceTypeList".

8.8.41.2 jurisdictionDomainType

This optional attribute defines the juridical domain of the object delimited, based on the code list "MG_JurisdictionDomainTypeList". See 8.8.35.

8.8.41.3 referencePoint

This optional attribute defines the coordinates of a point inside the space spatial unit. It is necessary for the point to be on the 2D surface upon which the space is projected.

8.8.41.4 volumeValue

This optional attribute identifies the volume of the space. This attribute makes use of the class LA_VolumeValue from ISO 19152-2.

8.8.41.5 verticalExtent relationship

This relationship between between MG_Zone spatial units and MG_Space spatial units describes a space as a surface with a vertical extent. An MG_Space spatial unit is an MG_Zone spatial unit with a height attribute above a base or textual description.

8.8.41.6 spatialVolume relationship

This relationship is an aggregation relationship of a feature unit as represented by MG_FeatureUnit to one or more spatial attributes that define the location and geometric shape of a volume. A volume is represented in 2 1/2 dimensions as a surface with a height. The relationship only supports the geometry type "Surface" with the attribute height and an offset.

8.8.41.7 additionalVolumeInfo relationship

This relationship is an aggregation relationship of a feature unit as represented by MG_FeatureUnit to additional thematic information related to volume spatial geometry. This allows for the description of the attribute "Location by Text" or a description of a volume/space or both, in a unique CRS that does not participate directly in a geometric complex.

8.8.42 MG_Volume

This component is a subtype of MG_Surface which describes a spatial attribute that takes on volume spatial geometry. It provides volume spatial geometry for a feature unit in a consistent coordinate reference system. A volume is represented in 2 1/2 dimensions as a surface with a height above a reference or a textual description. All attributes are inherited and described in the inherited classes.

8.8.43 MG_Volume_Attributes attributes

8.8.43.1 volumeVerticalPosition

This attribute defines a reference point used to establish a bound for the vertical extent of a volume using GM_Point geometry in accordance with ISO 19107, defining a reference from which to measure vertical extent.

8.8.43.2 volumeVerticalExtent

The vertical extent of a volume is established as a distance measured against a vertical position reference point. Vertical extent is given in the units established through "units of measure" (uom) defined for distance.

8.8.44 MG_SpaceTypeList

The code list MG_SpaceTypeList describes categories of "Space Type" that have a common characteristic related to the legal and administrative aspects of the marine environment. The code list does not contain any predefined space types, just the generic "space" type.

To extend beyond the list of space types given in this code list, the generic "space" type can be used. Alternatively, the code list can be registered in a feature concept dictionary as listed values and as such can be expanded to include all space types.

This code list takes on the following values:

— **space** — a volume which has a particular characteristic which is logically delimited by instances of "Volume".

8.8.45 LA_VolumeValue

The datatype LA_VolumeValue describes the volume of a feature unit and makes reference to its type.

The description of this code list is provided in ISO 19152-2.

8.9 Source section

8.9.1 Source section general

The description of the source of information is of fundamental importance for legal or official data. ISO 19152-1 provides the class LA_Source to describe source information. This class has been extended in this document (ISO 19152-3) to address the requirements of the marine space. For marine limits and boundaries and many other aspects of georegulation in the marine space, the source information is international conventions, treaties and national laws. These types of sources have their own context in which they are referenced. As such, the class LA_Source has been realized by the class MG_Source which carries additional attribution to address the marine space. Attribute names have been redefined, but the corresponding attribute in LA_Source is carried as an alias. Since S-100[18] does not support all of the metadata classes provided in ISO 19115-1, some of the attribute data types have been simplified be to text strings.

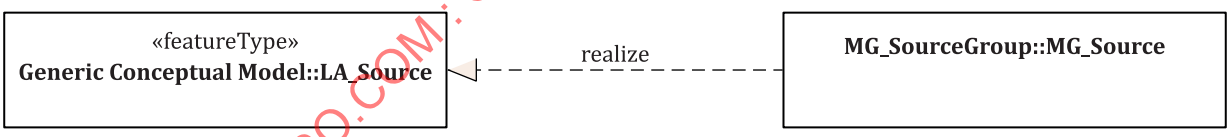

Figure 16 — Source section showing inheritance

Figure 17 shows the MG_Source section with attributes and relations.

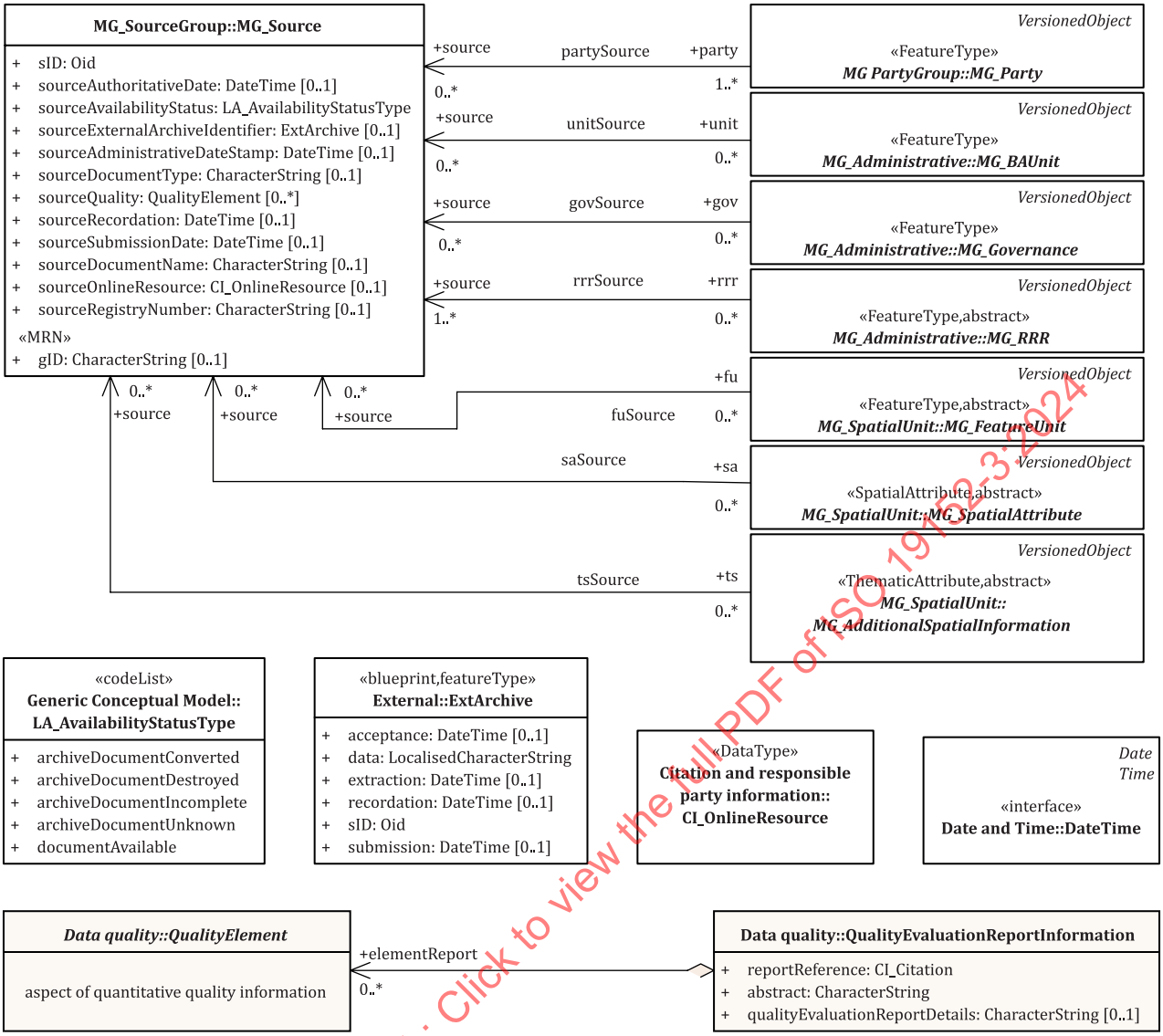

Figure 17 — Source section

The name DQ_Element was used to represent a data quality element in previous versions of ISO 19115-1 metadata. The name was changed to QualityElement in ISO 19157-1:2023. The old name DQ_Element is still used in some of the IHO standards. ISO 19152-3 is not a measurement standard. Limits and boundaries are defined by countries in national laws and regulations and are therefore implicitly correct. Therefore, only a small subset of the data quality applies. Only the QualityEvaluationReportInformation is used and this has the data type of a character string. As such this element is backward compatible with QualityElement and the older DQ_Element from the previous edition of ISO 19157.

8.9.2 MG_Source

The source unit provides descriptive documentation that supports, complements or describes the associated object. This object is realized from ISO 19152-1 "LA_Source". This is a realization relationship because all of the attributes from LA_Source are not inherited.

8.9.3 MG_Source attributes and relationships

8.9.3.1 sID

This attribute is the identifier of the source. This allows reference to "Source" information objects using the “Oid” attribute type. The “Oid” comprises a unique character string and a namespace identifier which is also a unique character string.

EXAMPLE "Source-9" where "Source" is the namespace identifier, "-" is a delimiter and "9" is the unique id within that namespace.

8.9.3.2 sourceAuthoritiveDate

This attribute defines the date of force of law of the "Source" by an authority. This attribute has been renamed to fit the context of the marine space.

8.9.3.3 sourceAvailabilityStatus

This attribute defines the availability status of source document. This attribute has been renamed to fit the context of the marine space.

8.9.3.4 sourceExternalArchiveIdentifier

This attribute defines the identifier of a "Source" in an external registration as per the description given in the class ExtArchive defined in ISO 19152-1.

8.9.3.5 sourceAdministrativeDateStamp

This attribute defines the moment that the event represented by the instance of "Source" is further processed. This is the moment of "endLifespan" of old instances, and the moment of "startLifespan" of new instances. This attribute has been renamed to fit the context of the marine space.

8.9.3.6 sourceDocumentType

This attribute defines the type of source document. This attribute has been renamed and generalized to fit the context of the marine space. The equivalent attribute from LA_Source takes its value from ISO 19115-1 metadata from the class CI_PresentationFormCode. This part of the ISO 19115-1 metadata standard is not included in S-100 Part 4 metadata.[18] Therefore, a free form character string is provided as the data type.

8.9.3.7 sourceQuality

This attribute defines the quality of the source. This attribute is inherited from LA_Source in ISO 19152-1. The treatment of quality is now addressed in ISO 19157-1 as a "Quality Report" in a simpler manner to the set of quality attributes that were previously part of metadata. This approach is used because it is more general than the previous approach used in ISO 19115:2003 and S-100.[18]

8.9.3.8 sourceRecordation

This attribute describes the date of registration (recordation) of the "Source" by the registering authority.

8.9.3.9 sourceSubmissionDate

This attribute defines the date of submission of the "Source" by a party. This attribute has been renamed to fit the context of the marine space.

8.9.3.10 sourceDocumentName

This attribute defines the name of the document that defines the object. For simplicity, the metadata CI_ResponsibilityParty structure referenced in LA_Source from ISO 19152-1 has been restructured to be a source reference in the style used in the legislative, treaty or other marine space environment represented as a character string.

8.9.3.11 sourceOnlineResource

This attribute provides the URL (or equivalent online resource) where the document is distributed.

8.9.3.12 sourceRegistryNumber

This attribute describes the unique official identifier of the record in a registry. For example, the identifier can follow the methodology in states with registers of legislative instruments. Document level versioning is controlled by the registry ID.

8.9.3.13 <MRN>gID

The MRN is an optional identifier in the marine space that is a permanent global identifier, allowing marine space management. The IHO provides guidance on the structure of the MRN as a GUID. See 8.3.

8.9.3.14 partySource relationship

This relationship of a party to source information describing the party is from MG_Party to MG_Source.

8.9.3.15 unitSource relationship

This relationship of a basic administrative unit as represented by MG_BAUnit to source information describing that the administrative unit is from MG_BAUnit to MG_Source.

8.9.3.16 govSource relationship

This relationship is of a governance unit, as represented by MG_Governance, to source information as represented by MG_Source. The MG_Governance class contains legal, treaty or other definitive text describing a single or group of administrative BAUnits.

8.9.3.17 rrrSource relationship

This relationship is of an RRR as represented by MG_RRR to source information describing that RRR. The relationship is from MG_RRR to MG_Source.

8.9.3.18 fuSource relationship

This relationship is of a feature unit as represented by MG_FeatureUnit to source information describing the feature. The relationship is from MG_FeatrureUnit to MG_Source.

8.9.3.19 saSource relationship

This relationship is of a spatial attribute as represented by MG_SpatialAttributeType to source information. The relationship is from MG_SpatialAttributeType to MG_Source.

8.9.3.20 tsSource relationship

This relationship is of additional spatial information as represented by MG_AdditionalSpatialInformationType to source information. This relationship is from MG_AdditionalSpatialInformationType to MG_Source.