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GEOINT Structure Implementation Profile Schema Processing

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2007-04-09	0.5	CP		Revision based on comments by Hugh Bryant
2007-5-02	0.5	Carl Reed	Cover page, headers, etc	Get ready for posting as a DP.

iv. Changes to the OpenGIS® Abstract Specification

The OpenGIS® Abstract Specification does not require changes to accommodate the technical contents of this document.

Foreword

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium Inc. shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the specification set forth in this document, and to provide supporting documentation.

Introduction

This document contains a description of the schema tailoring process for application schema development based on the U.S. National System for Geospatial-Intelligence (NSG) GEOINT Structure Implementation Profile (GSIP) as developed in conjuction with the Open Geospatial Consortium Interoperability Program initiative OWS-4. In particular it discusses:

- Creation of ISO 19109 (Geographic information - Rules for application schema) conformant Application Schemas in UML from the GSIP

- Derivation of the GML Application Schemas using the ShapeChange UML-to-GML-Application-Schema conversion tool

- Metadata describing GSIP-based application schemas to support their discovery and assessment using CS-W 2.0 services based on the ebXML Registry Information Model

GEOINT Structure Implementation Profile Schema Processing

1 Scope

This OpenGIS® document describes and discusses the process of creating application schemas in support of the NSG from NGA data based on the GEOINT Structure Implementation Profile (GSIP) which has been based on the NSG Feature Catalog.

The approach used to create the application schemas starts with the creation of ISO 19109 conformant application schemas in UML. These UML models are then used as input to the Shape Change UML to GML conversion tool deriving GML application schemas from the UML models in an automated process.

This document also discusses schema metadata and it's use in an OGC compliant Catalogue Service for the purpose of discovery and retrieval.

2 Conformance

Not required for an IP IPR, DIPR, or Discussion Paper.

3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

GEOINT Structure Implementation Profile, Version 1.8 (draft)

NOTE This document can be obtained from http://www.nga.mil/portal/site/nga01/standards/GSIP.

ISO/TS 19103:2005, *Geographic Information – Conceptual Schema Language*

NOTE This document can be obtained from the International Organisation for Standardisation.

ISO 19109:2004, *Geographic Information – Rules for Application Schemas*

NOTE This document can be obtained from the International Organisation for Standardisation.

ISO 19136:--, Geographic Information – Geography Markup Language (GML)

NOTE This document can be obtained from the Open Geospatial Consortium Inc. or the International Organisation for Standardisation; the version used for drafting this document is ISO/DIS 19136, i.e. GML 3.2.0.

ISO/TS 19139:--, Geographic Information – Metadata – XML Schema Implementation

NOTE This document can be obtained from the International Organisation for Standardisation; the version used for drafting this document is the version submitted by ISO/TC 211 to ISO Central Secretariat for publication as ISO/TS 19139.

Catalogue Service 2.0.1, OGC Implementation Specification

NOTE This document can be obtained from the Open Geospatial Consortium Inc.

Catalog Service 2.0 ebRIM Application Profile, OGC Recommendation Paper

NOTE This document can be obtained from the Open Geospatial Consortium Inc.

Department of Defense Discovery Metadata Specification (DDMS), Version 1.3, provided by NGA

NOTE This document can be obtained from. https://metadata.dod.mil/mdr/irs/DDMS/index.html

DGIWG/TSMAD Profile, Profile(s) of ISO 19107 that support two-dimensional topology

NOTE This document can be obtained from https://portal.dgiwg.org/

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

4 Terms and definitions

-

5 Conventions

5.1 Symbols (and abbreviated terms)

ISO International Organization for Standardization

OGC Open Geospatial Consortium

GML Geography Markup Language

UML Unified Modeling Language

XML	eXtended Markup Language
1D	One Dimensional
2D	Two Dimensional
3D	Three Dimensional
NGA	National Geospatial-Intelligence Agency
DFDD	DGIWG Feature Data Dictionary
NSG	National System for Geospatial-Intelligence
NSG FC	NSG Feature Catalog
WFS	Web Feature Service
FACC	Feature and Attribute Coding Catalogue
DIGEST	Digital Geographic Information Exchange Standard
MSD	Mission Specific Data
GSIP	GEOINT Structure Implementation Profile

5.2 UML Notation

The diagrams that appear in this document are presented using the Unified Modeling Language (UML) static structure diagram based on the rules of ISO/TS 19103 (Geographic information – Conceptual schema language) and ISO 19136 (Geographic Information – Geography Markup Language, GML 3.2.1) Annex E.

The UML notations used in this document are described in the diagram below.

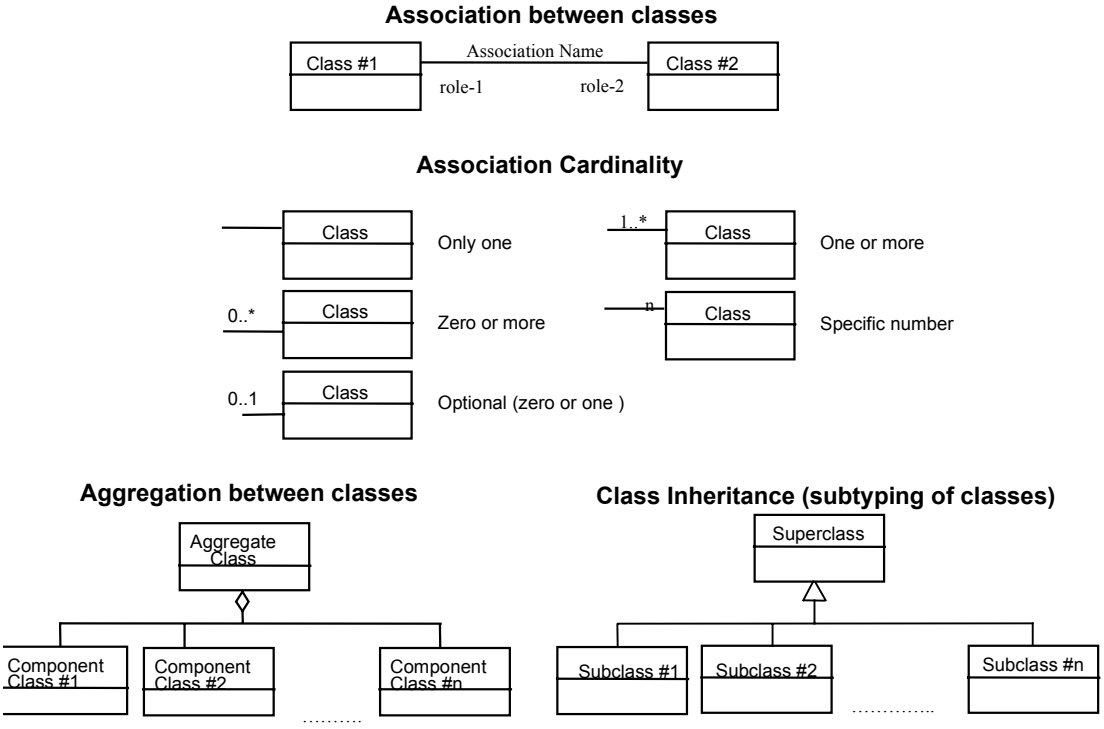


Figure 1 — UML notation

In the class diagrams, the following stereotypes of UML classes are used:

a) <<DataType>> A descriptor of a set of values that lack identity (independent existence and the possibility of side effects). A DataType is a class with no operations whose primary purpose is to hold the information.

b) <<BasicType>> A special type of a DataType that typically has a canonical representation in a computing platform, in this case XML Schema.

c) <<CodeList>> is a flexible enumeration that uses string values for expressing a list of potential values.

d) <<Enumeration>> is a fixed list of valid identifiers of named literal values. Attributes of an enumerated type can only take values from this list.

e) <<Union>> is a list of attributes. The semantics is that only one of the attributes can be present at any time.

In this document, the following standard basic data types are used:

a) CharacterString – A sequence of characters

b) Integer – An integer number

c) Real – A floating point number

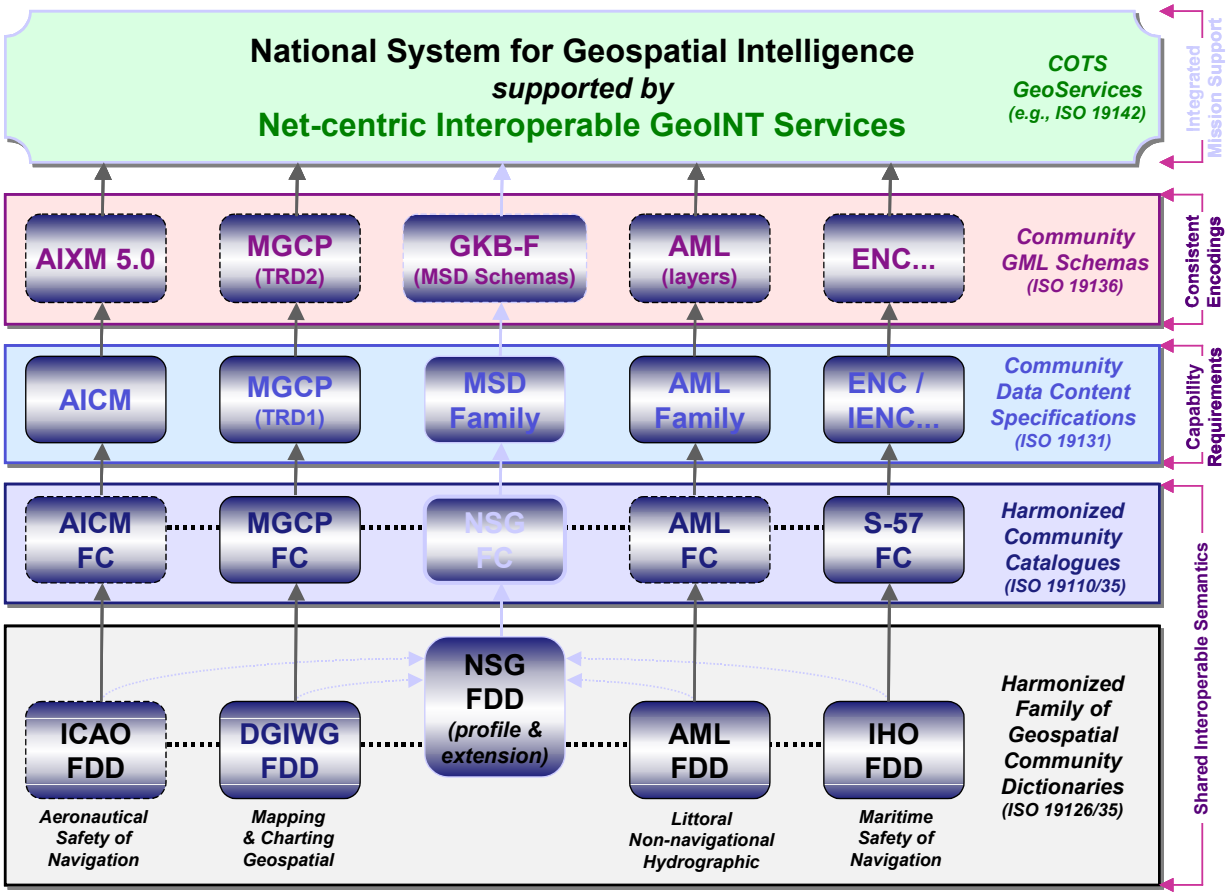
d) Boolean – A boolean value (true or false)

e) Measure – A numeric value associated with a unit of measurement

6 GSIP-based application schema development

6.1 The NSG Feature Catalog Stack

The figure below shows the different layers of the "NSG Feature Catalog Stack" (middle column) and its environment, which are discussed in more detail in the subsequent subclauses.



From: „The NSG Feature Catalog Stack: An Overview" (P. Birkel, R. Buckley, A. Steuber)

6.2 Feature data dictionaries

The DGIWG Feature Data Dictionary (DFDD) contains geographic information concepts used by member states of the DGIWG community to characterize aspects of features, i.e.

real world phenomena. It is the successor of the Feature and Attribute Coding Catalogue (FACC), a component of the Digital Geographic Information Exchange Standard (DIGEST).

The NSG FDD is the DFDD-based feature data dictionary as specified by NGA/NCGIS. It is a subset of the DFDD without items that are not relevant for NGA, but a number of extensions have been added to represent information used by NGA and its customers; the extensions are often drawn from other data dictionaries.

The proposed ISO 19126 (Geographic information – Feature concept dictionaries) is the underlying abstract specification of the feature data dictionaries.

6.3 Feature Catalogs and the GSIP

The NSG Feature Catalog draws from the concepts (feature types, attributes types, enumerants, etc.) defined in the NSG FDD and binds them together in a feature catalog according to ISO 19110 (Geographic information – Methodology for feature cataloguing).

Objectively, the NSG Feature Catalog will authoratively specify the GEOINT data elements. Feature catalogs that document the data elements used in a specific community or application, e.g. the Local MSD Feature Catalog, is a subset of the NSG Feature Catalog.

In order to define application schemas that are an ISO 19109 conformant specification of the feature types and their properties in a formal conceptual schema language, more information is needed than typically contained in a feature catalog. Therefore, the term "GEOINT Structure Implementation Profile" (GSIP) is used to denote the extended version of the NSG Feature Catalog that contains this additional information.

6.4 Application schemas and implementation specifications

The intent is that GSIP contains all required information so that schema representations for the whole NSG Feature Catalog or any profile like Local MSD can be derived through fully automated processes from the GSIP.

Target schema representations in OWS-4 are

- ISO 19109 application schemas in UML to represent the conceptual model
- GML 3.2.1 application schemas to make NSG data available through services like the Web Feature Service

Additional implementation representations, e.g. for ESRI Shape file, SQL database management systems, Java classes, etc. could in principle be derived as well.

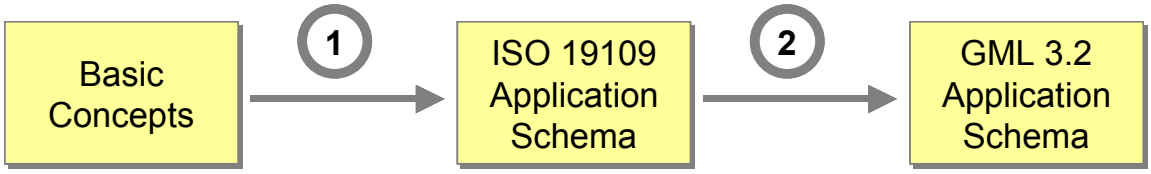
6.5 Scope within OWS-4

This subclause describes the work done within OWS-4 in the context of the NSG Feature Catalog stack:

- All application schemas were created based on product profiles of the GSIP, derived automatically from the GSIP. These schemas include the full GSIP schema, the Local MSD and the DAFIF Ed. 9 schema. The content of Vertical Obstructions and Stereo Airfield Collection schemas is available and the associated GML application schemas can be derived automatically by the process described in this document. As said above, the product profiles are all strict subsets of the GSIP, which is based on the NSG FC as the common feature catalog for NGA data (and the GKB).
- Based on the scripts developed in OWS-3, NGA has created scripts that create a Rational Rose UML model from the GSIP or one of the derived product profiles.
- The mapping rules from the GSIP metamodel to the UML application schema taking ISO 19109, ISO/TS 19103 and the ISO 19136 (Geographic information – Geography Markup Language, GML) based GML application schema derivation into account. This has been done in several iterations.
- The GSIP identifies a whole series of feature level metadata.
- The ShapeChange UGAS tool has been updated as required to address all information encoded in the UML model. The target GML version is GML 3.2.1.
- A GML profile for GSIP has be created and documented.
- Schema metadata to be published in the OWS-4 catalogs for an application schema has been specified. The target is discovery metadata based on DDMS 1.3. Schema metadata includes information about application schemas, feature types, property types and views (see 7.4).

6.6 Application schema creation process

The simplified process is described in the following figure:

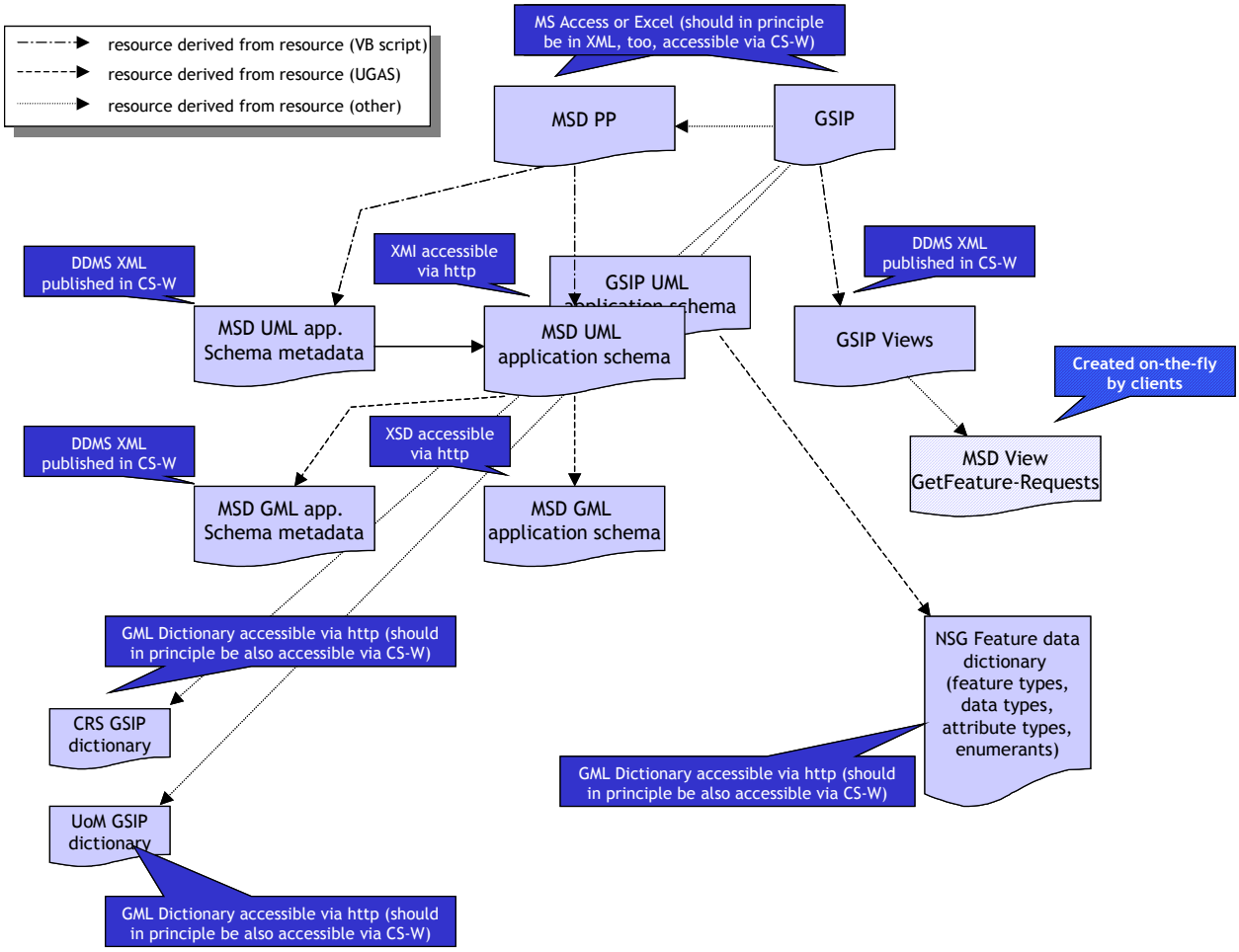


Step (1) is executed using an application creating a Rational Rose UML model from the GSIP maintained by NGA. The application is implemented in Visual Basic.

Step (2) is executed using the Open Source UGAS tool “ShapeChange” developed by interactive instruments (ii). More information about the tool including documentation can be found at http://www.interactive-instruments.de/ugas/. The tool documentation includes

one document describing the mapping rules from UML to GML as implemented by the tool plus a second document describing the implementation of the ShapeChange tool, its installation and guidelines for using the tool.

The process in more detail is shown as a MSD example in the figure below:

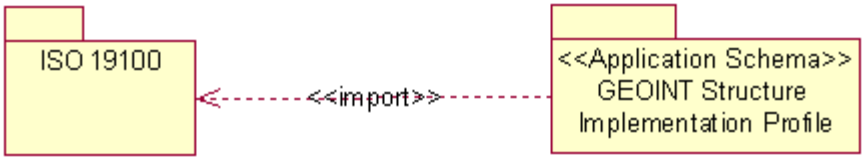


7 ISO 19109 Application Schema in UML

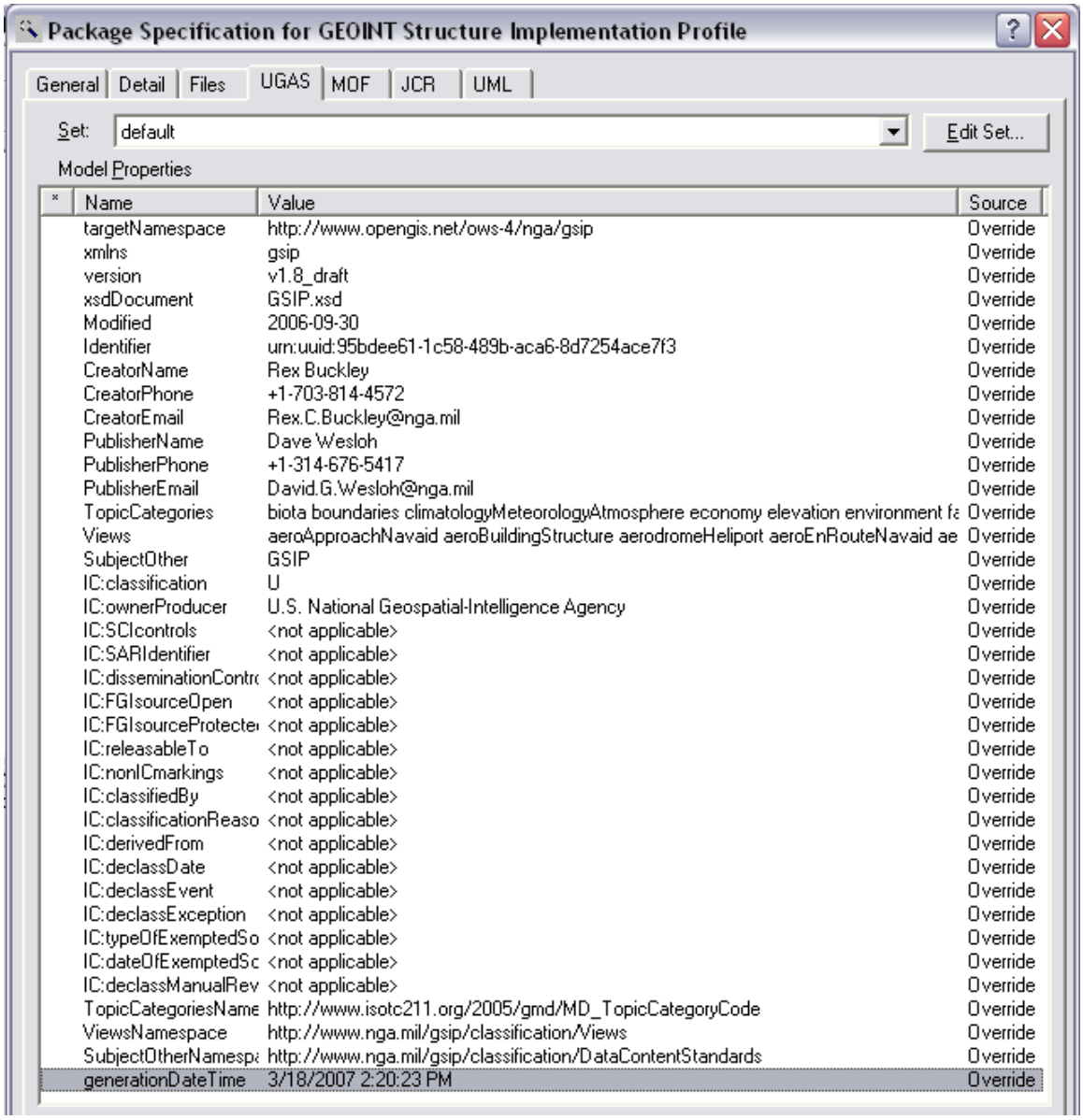
7.1 Package structure

The following UML packages were created by the script:

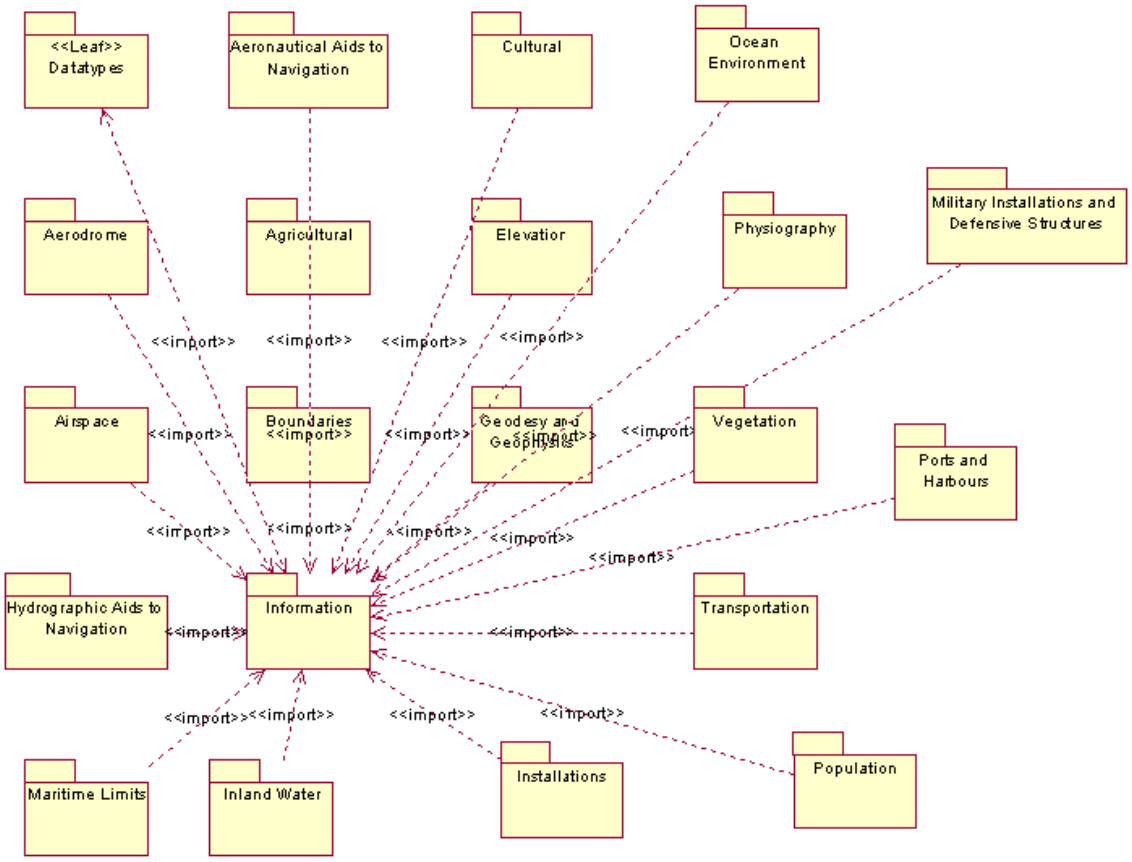
- A root package for the GSIP or the product profile (stereotype <<Application Schema>>) in addition to the ISO 19100 harmonized model. The package is marked as dependant on the Harmonized Model of the ISO 19100 series.



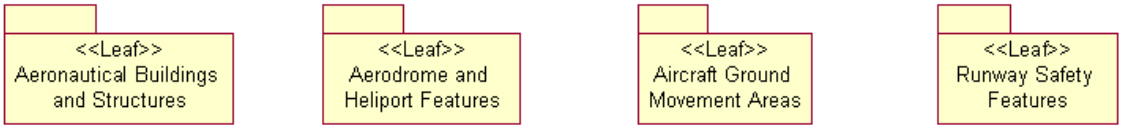
- Tagged values are added to the application schema package to associate the application schema with
    - an XML namespace for the GML application schema (see GML Annex E)
    - an XML namespace prefix for the GML application schema document (see GML Annex E)
    - an XML Schema document representing the root document of the GML application schema (see GML Annex E)
    - a version number (see GML Annex E)
    - a modification date
    - date and time of the schema generation
    - a unique identifier
    - a creator (see ISO 19115 and DDMS)
    - a publisher (see ISO 19115 and DDMS)
    - a list of topic categories (see ISO 19115 MD_TopicCategory) and a namespace for the coded values
    - a list of views (see 7.4) and a namespace for the coded values
    - a list of other subject categories and a namespace for the coded values
    - IC security classifications (see Intelligence Community Information Security Marking)



- Within the root package, sub-packages are created for categories defined in the NSG Feature Catalog (e.g. “Aerodrome”, “Agricultural”, etc.).



- Within each category package another package for each sub-category (e.g. within "Aerodromes": "Aeronautical Buildings and Structures", etc.). As packages without sub-packages these were tagged with the stereotype <<Leaf>>.



- The tagged values "targetNamespace", "xmlns", "xsdDocument" and "version" are set for the package with stereotype <<Application Schema>>. The tagged value "xsdDocument" may also be set for sub-packages.

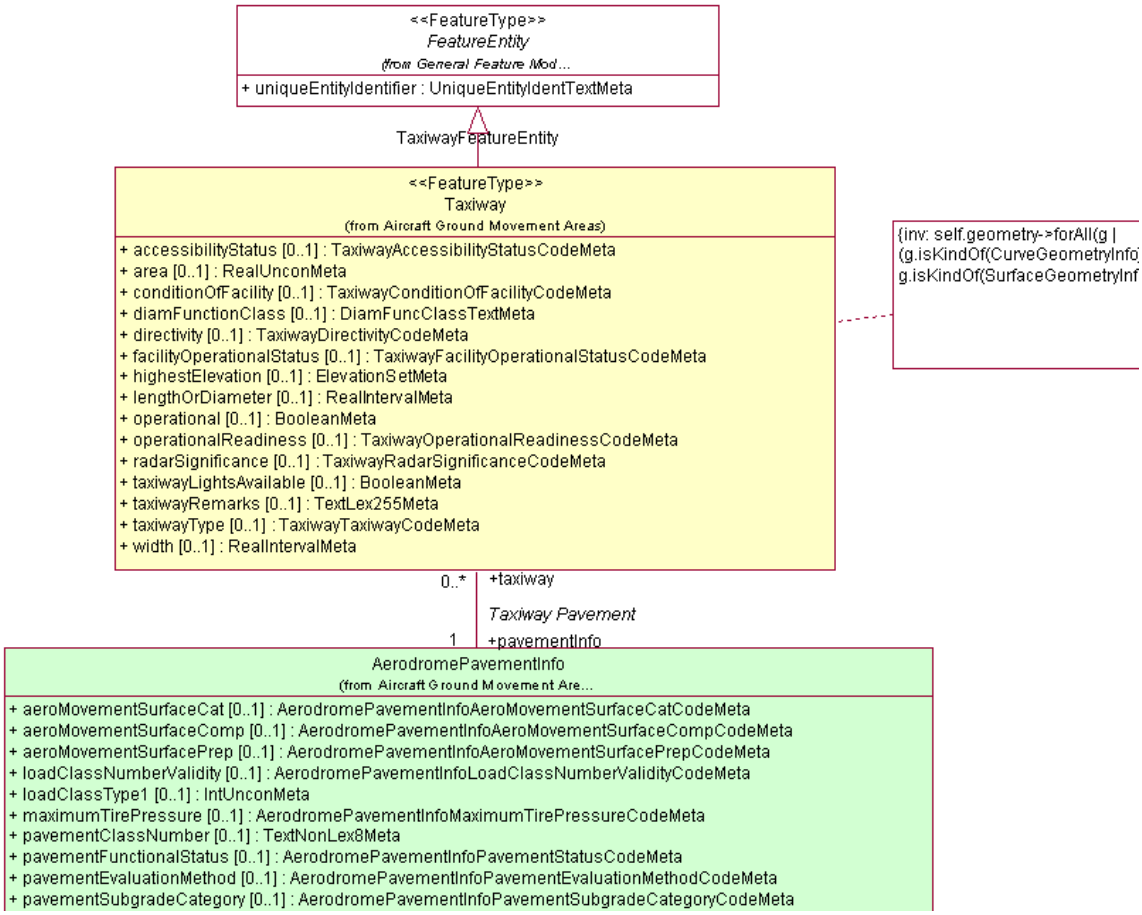
7.2 Feature types and associated data types

The following feature type classes were created by the script:

- An abstract feature type "FeatureEntity" which adds a number of predefined properties. All other feature types are suptypes of this type.

- All feature types have a stereotype <<FeatureType>>.

- One class per feature type in the NSG Feature Catalog using the alpha codes as names of the class, attributes and association roles.



- This code has also added in a tagged value “primaryCode”. The DFDD code has added in a tagged value “secondaryCode” which may be used for mappings to implementation platforms that limit the length of name fields (eg shape files).

- The human readable name is added in the tagged value “Title”.

- The feature type is associated with the ISO 19115 (Geographic information – Metadata) topic categories listed in the tagged value “TopicCategory”. Tagged value “TopicCategoryNamespace” has a unique namespace for these keywords, in this case fixed to “http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode”.

- The feature type is also associated with the views listed in the tagged value “Views”. “ViewsNamespace” again has a unique namespace for these keywords, in this case fixed to “http://www.nga.mil/gsip/classification/Views”.

- The feature type is associated with other keywords listed in the tagged value "SubjectOther". "SubjectOtherNamespace" again has a unique namespace for these keywords which may vary from application schema to application schema. In the example the keyword "GSIP" was added.

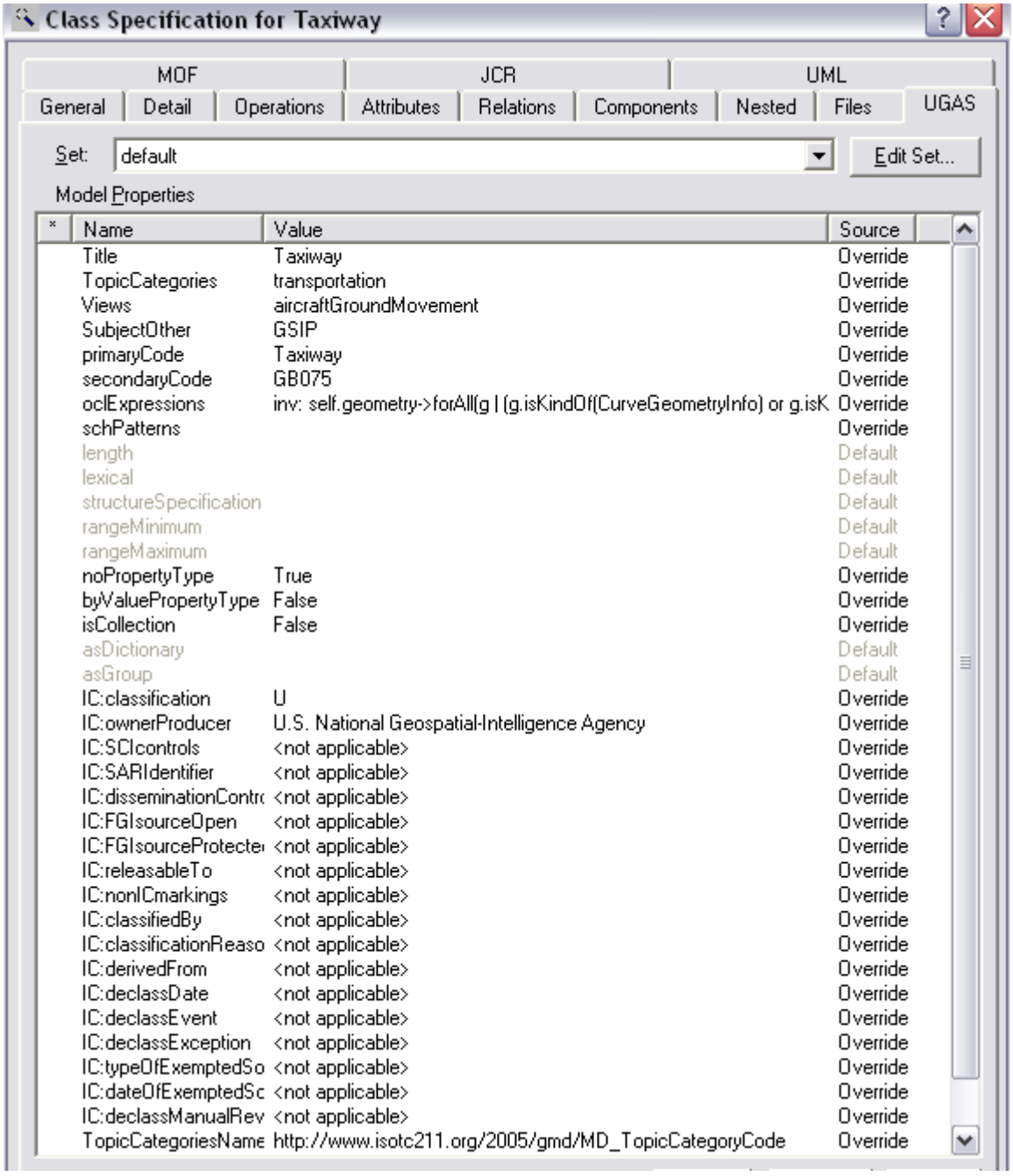
- The tagged value "oclExpressions" allows capture of additional constraints related to the feature type using OCL. These constraints are typically also shown in the class diagram showing the feature type. In case of the taxiway, the invariant constraint "self.geometry->forAll(g | (g.isKindOf(CurveGeometryInfo) or g.isKindOf(SurfaceGeometryInfo))" specifies that geometries are either curves or surfaces (but not points).

- The tagged value "schPatterns" is a placeholder for a translation of the "oclExpressions" to Schematron for the implementation of the feature type in a GML application schema. used in the OWS-4 application schemas.

- The tagged values "noPropertyType" (always true), "byValuePropertyType" (always false) and "isCollection" (false) capture information for the GML application schema implementation and are as specified in the GML specification in Annex E.

- The "IC:…" tagged values provide security classiciation information based on the Intelligence Community Metadata Standards for Information Assurance referenced from DDMS. See in particular the "Information Security Marking Implementation Guide".

- The other tagged values are not relevant for classes that are feature types.



*	Name	Value	Source
	Title	Taxiway	Override
	TopicCategories	transportation	Override
	Views	aircraftGroundMovement	Override
	SubjectOther	GSIP	Override
	primaryCode	Taxiway	Override
	secondaryCode	GB075	Override
	oclExpressions	inv: self.geometry->forAll(g | (g.isKindOf(CurveGeometryInfo) or g.isK	Override
	schPatterns		Override
	length		Default
	lexical		Default
	structureSpecification		Default
	rangeMinimum		Default
	rangeMaximum		Default
	noPropertyType	True	Override
	byValuePropertyType	False	Override
	isCollection	False	Override
	asDictionary		Default
	asGroup		Default
	IC:classification	U	Override
	IC:ownerProducer	U.S. National Geospatial-Intelligence Agency	Override
	IC:SCIcontrols	<not applicable>	Override
	IC:SARIdentifier	<not applicable>	Override
	IC:disseminationContr	<not applicable>	Override
	IC:FGIsourceOpen	<not applicable>	Override
	IC:FGIsourceProtecte	<not applicable>	Override
	IC:releasableTo	<not applicable>	Override
	IC:nonICmarkings	<not applicable>	Override
	IC:classifiedBy	<not applicable>	Override
	IC:classificationReaso	<not applicable>	Override
	IC:derivedFrom	<not applicable>	Override
	IC:declassDate	<not applicable>	Override
	IC:declassEvent	<not applicable>	Override
	IC:declassException	<not applicable>	Override
	IC:typeOfExemptedSo	<not applicable>	Override
	IC:dateOfExemptedSc	<not applicable>	Override
	IC:declassManualRev	<not applicable>	Override
	TopicCategoriesName	http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode	Override

For every attribute of the feature type in the NSG Feature Catalog, one attribute was added to the class. Again, the alpha code is used, e.g. “accessibilityStatus”. Attributes are typically optional.

For attributes and association roles the following tagged values are set:

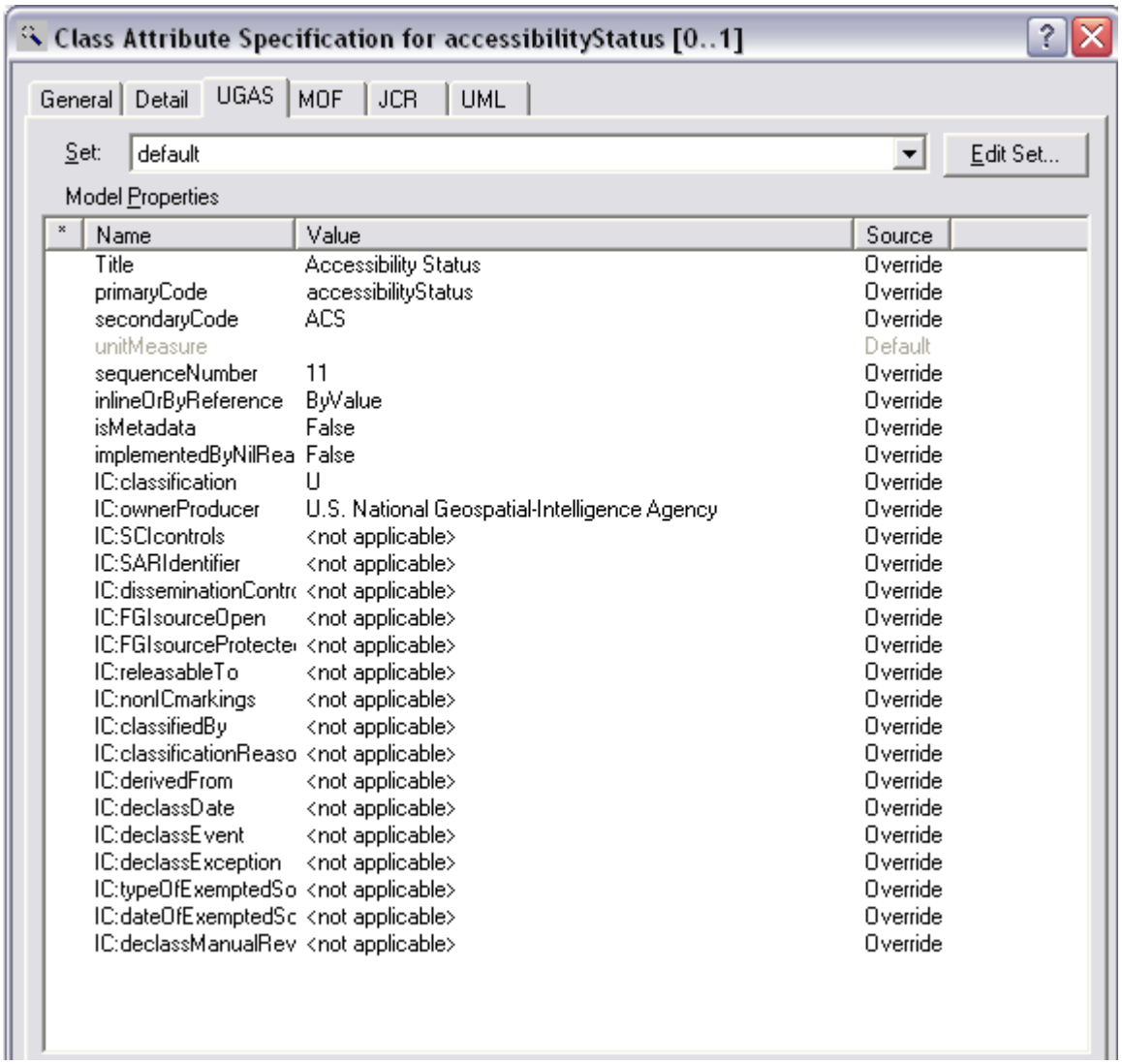
- “Title”, “primaryCode”, “secondaryCode”, “IC:…” as for feature types.
- “sequenceNumber” is a unique number within the context of the property as

specified in GML Annex E and is used in the GML application schema implementation.

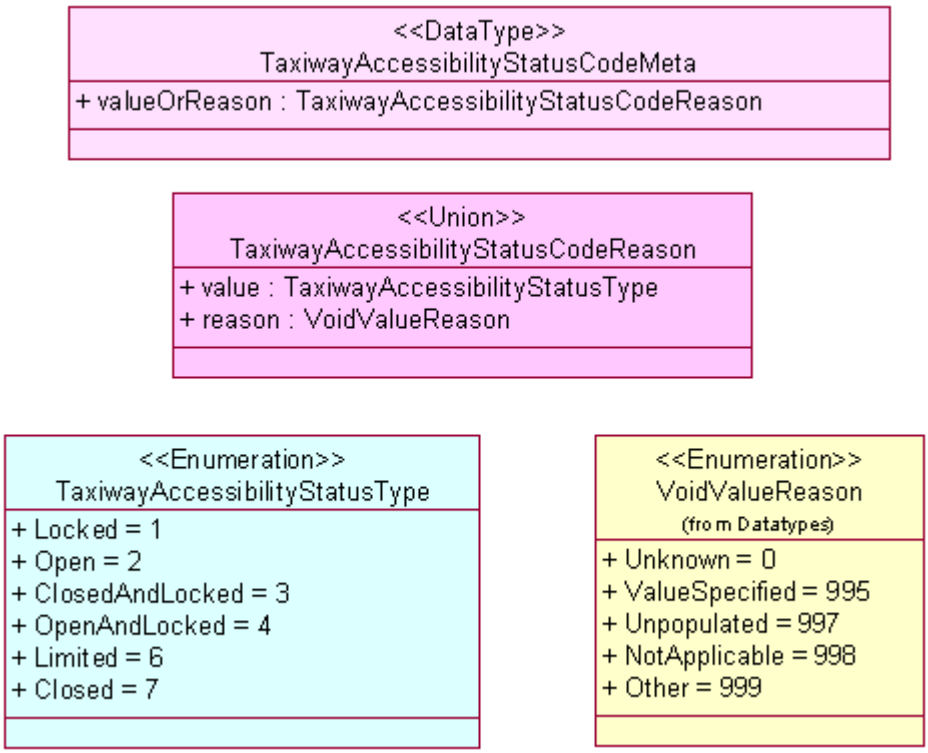
- "inlineOrByReference" specifies the encoding pattern in the GML application schema implementation and is set according to the rules in GML Annex E.

- "isMetadata" specifies whether the value of the property is metadata. This information is used in the GML application schema implementation and is set according to the rules in GML Annex E, but it may be useful also in other implementations.

- "implementedByNilReason" is also used in the GML application schema implementation and is an extension to GML Annex E. It is always false in data types.

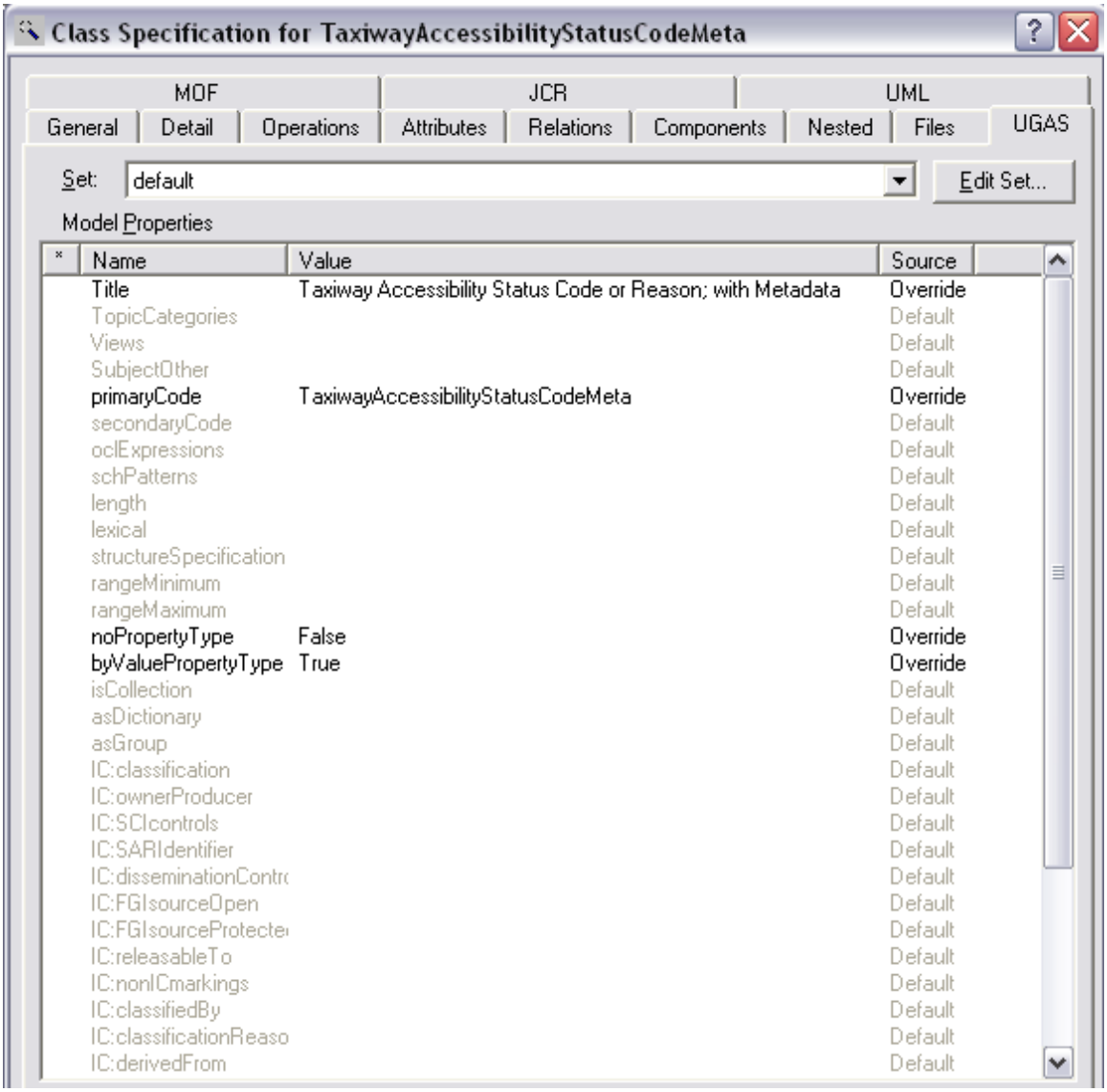


A general pattern used for attribute values is that additional metadata (e.g. about releasability) may be added or that reasons for missing values (void as specified in ISO 10404) may be provided. This is modelled on the conceptual level as

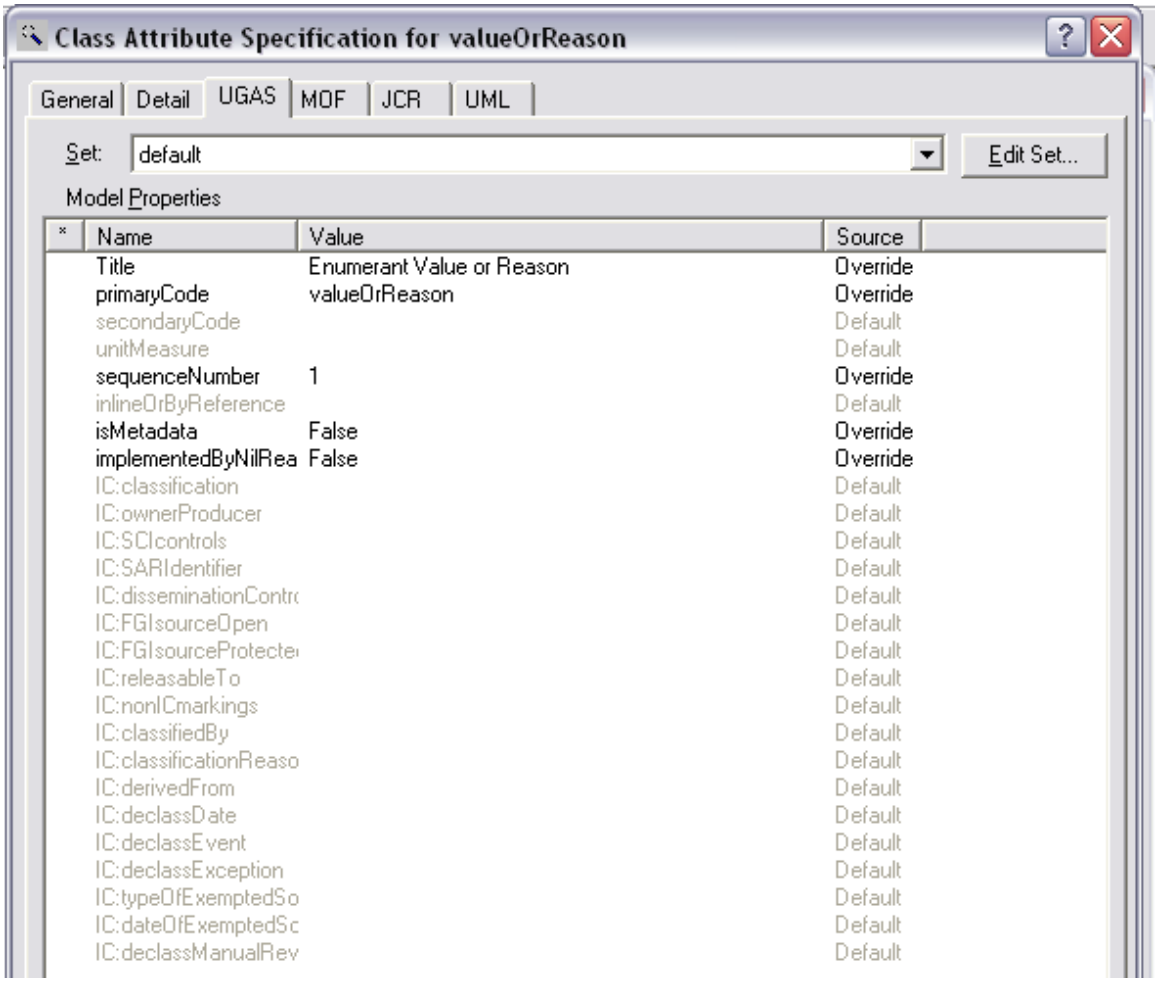


The data type of the attribute (here "TaxiwayAccessibilityStatusCodeMeta") has a property "valueOrReason" with the actual value of the attribute – or a reason for a void value. In addition, metadata properties may be added in this type.

The tagged values described above "Title" (human readable name), "primaryCode" (name of class), "noPropertyType" (false), "byValuePropertyType" (true) are set for the <<DataType>> class.



The following figure shows the tagged values for the “valueOrReason” attribute.



The tagged values for the <<Union>> class are using the same pattern as the <<DataType>> class. The only addition is the tagged value “asGroup” which is used in the GML application schema implementation and is an extension to GML Annex E. It is set to “true” and specifies the union is implemented as a group and not a complexType in XML Schema.

The tagged values of the other classes and attributes follow the pattern described above. The only noteworthy setting is in the “reason” property, where “isMetadata” is set to “true” as is “implementedByNilReason” which is used in the GML application schema implementation to map this property to make value nillable and allow qualifying a nil value with a nilReason value.

Otherwise the following attribute types can be distinguished:

- Attributes with coded values: In this case, the allowed coded values for the respective feature type are captured in a enumeration class (stereotype <<Enumeration>>, see TaxiwayAccessibilityStatusType above). Since the coded values are different for each class, the uniqueness is guaranteed by

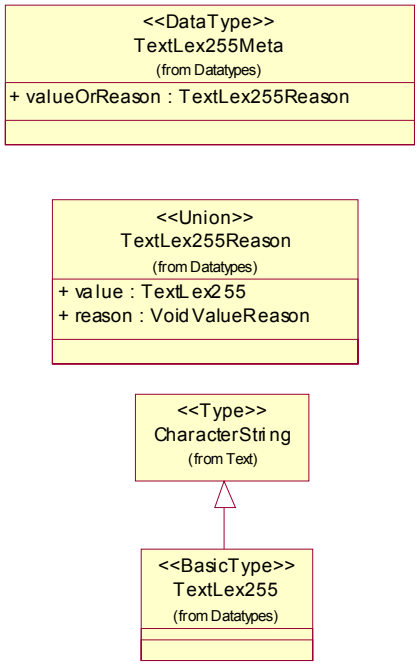
naming the class by a concatenation of the feature type name and the attribute name. Each coded value is represented with its textual description and code value. The same is true for the reasons for void values.

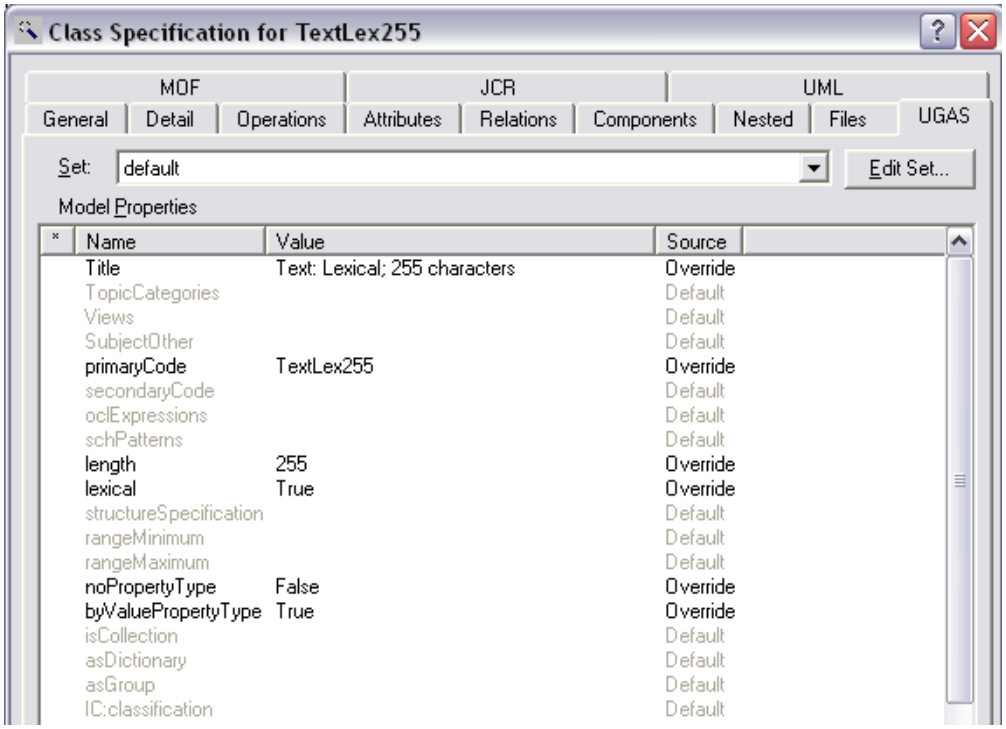
ISO/TS 19103 distinguishes enumerations (fixed lists of values) and code lists (lists of values that can be maintained seperately from the schema).

Since the allowed values are fixed for a certain version of the NSG Feature Catalog, the coded values are modelled as enumerations and not as code lists; as a result they are "tied" to the schema (consequently, an XML parser can validate if a coded value is allowed or not for a specific feature instance – something which would not have been true for a code list approach).

Still all coded values are also documented in a separate GML dictionary to allow for the translation from code value to textual description (and vice versa) by applications.

- Other Attributes: These attributes are attributes with either a string value, a numeric value or a complex data type value with sub-elements. String values are often associated with a maximum length. Numeric values are often values associated with a unit of measurement, a minimum and maximum value. If existing, this information is captured in tagged values of classes for the attribute type, which are subtypes of the respective ISO/TS 19103 basic type and where the <<BasicType>> stereotype indicates a canonical representation in typical implementation platforms as a simple type. The class is modelled as a specialisation of the ISO/TS 19103 basic type (typically Real, Integer, CharacterString). The tagged values “length”, “rangeMinimum” and “rangeMaximum” may be used to provide constraints that may be used in the mapping to an implementation platform.

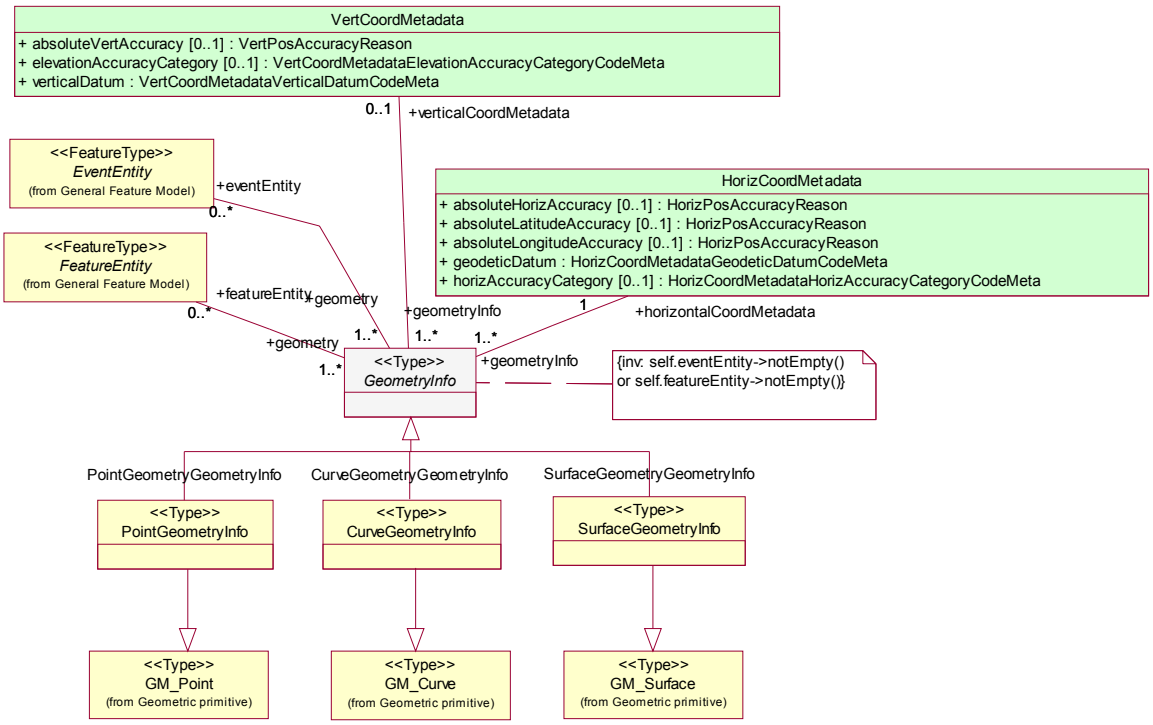




7.3 Information entities

In addition to the feature types, a number of object types are currently defined in the NSG Feature Catalog. They follow the same rules as the feature types but have no stereotype.

A special case are the geometry object types (see figure below which does not show all properties) which are defined as subtypes of GM_Point/GM_Curve/GM_Surface from ISO 19107 (Geographic information – Spatial schema). They also inherit from an abstract type "GeometryInfo" which adds the association to the features (ie. every feature can in principle have geometies unless additional constraints are provided) and to metadata about the geometry.



7.4 Views

The GSIP also provides a loose grouping mechanism, called"Views". Information entities, in particular feature types, can be associated with one or more views, and those views are organized into groups. Entity views are provided as a means to organize subsets of the NSG FC for the purposes of inspecting "similar entities".

7.5 Open issues

7.5.1 Codes and dictionary references

In the enumerations, there is no reference where the description of the meaning of the value of the enumerants can be found. So either the application knows where to find the dictionary (i.e. is "GSIP-aware") or this could be encoded as explicitly. Since in this case the stability of the list of values is not/cannot be enforced in the schema itself, this would

result in the use of the stereotype <<CodeList>> instead of <<Enumeration>> and the tagged value “asDictionary” set to ”true”.

EXAMPLE:

```
<conspicuousGroundCategory codeSpace=”URI of the NSG dictionary in the
appropriate version”>Visual</conspicuousGroundCategory>
```

The current verson of the GSIP UML application schema subdivides the documentation and can be parsed. For example, the entry for *Visual* is: "Visual: Conspicuous visually. [desc] Conspicuousness by radar unspecified." Here, "[desc]" indication the end of the text representing the definition and the start of text providing an additional description.

In general, the code list ditionaries should reside in a registry so that it can be accessed.

7.5.2 General relationship between feature catalog and application schema

Where is the break between an Application Schema and a Feature Catalog?

The GSIP Access database contains much more than an Application Schema or a Feature Catalog.

When the term Feature Catalog is used, this indicates an ISO 19110 Feature Catalog. It does not contain any information about “views” like those specified in the GSIP, etc., as these concepts are not defined in ISO 19110.

The UML model is intended to be an Application Schema, but with a few extensions which are represented in tagged values. These additions can be grouped into four aspects:

- Information from the feature catalog. Examples: codes and name/title of a feature type
- Schema metadata. Examples: DDMS/IC metadata elements that cannot be derived from the application schema itself
- Association of feature types with views (tagged value "Views", also used as schema metadata).
- GML encoding hints. Examples: targetNamespace (from GML 3.2 Annex E), isMetadata (from GML 3.2 Annex E), asGroup (extension)

In general there is overlap between a Feature Catalog (focus: semantics) and an Application Schema (focus: structure). E.g., an Application Schema does not *only* contain the structural information, but ISO 19109 requires that "an application schema shall be documented."

This is also an issue in ISO Technical Committee 211 (Geographic Information/Geomatics) in general which was brought up in recent discussions and different communities have slightly different roles for Feature Catalog and Application Schema in their processes.

7.5.3 Creating a units dictionary from DFDD/DTD

Below is a units dictionary partially filled with contents from the DTD register of DGIWG. The comments discuss how the information from the DTD could be automatically entered into the dictionary and list the issues with mapping from the DTD to a GML "units" dictionary. It is currently unclear how the units section in DGIWG's DTD relates to units catalogues/dictionaries as specified in ISO/TS 19139 and ISO 19136. This topic would need to be discussed with DGIWG, if the units dictionary should be derived automatically from the DTD.

- Every Unit of Measure in the DTD is mapped to a BaseUnit, DerivedUnit or ConventionalUnit.

  Issue: It is unclear how the seperation into BaseUnit, DerivedUnit or ConventionalUnit can be made based on the information in the DTD.

- gml:id has been set to the code

- gml:description has been set to the value of documentation and description separated by " Note: ".

- gml:identifier has been set to the code where the codespace is a URI identifying the DTD (perhaps a better and more stable codespace should be used, if one is specified by DGIWG)

- gml:name has been set to the name, the codespace is optional, but should be a URI identifying the DTD.

- gml:quantityType has been set to the name of the associated Quantity Equivalence Category, the element contains an informal description of the phenomenon or type of physical quantity that is measured or observed. As an alternative, the definition of the Quantity Equivalence Category could be added, e.g. in paranthesis.

- *Issue: The usual catalog symbols cannot be determined from the DTD (note that this element is optional in the units dictionary and could also be left out, but it may be helpful for user interfaces).*

- *Issue: The units system cannot be determined from the DTD.*

- *Issue: The individual terms of a derived unit cannot be determined from the DTD.*

- *Issue: Some conventional units are explicitly expressed in the DTD, e.g. there is gram and kilogram, although these are not identifable as such.*

- *Issue: The Units multiple information could be used to create combinations for all units as a combination of multiple and unit, but this seems too much.*

- *Issue: In the conventional units, how to combine the combination of units multiple and unit code/name? Concetanating them gives names/codes.*

```
<Dictionary xmlns="http://www.opengis.net/gml/3.2"
 xmlns:gml="http://www.opengis.net/gml/3.2"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xsi:schemaLocation="http://www.opengis.net/gml/3.2
  http://www.portele.de/gml/3.2.1/ISO_19136_Schemas/gml.xsd"
 gml:id="units">
 <description>A dictionary of units of measure specified within GSIP
based on the DFDD. This dictionary was created as part of the OWS-4
initiative.</description>
 <identifier
  codeSpace="http://www.nga.mil/gsip">UnitsDictionary</identifier>
 <name>GSIP Units Dictionary</name>
 <dictionaryEntry>
  <BaseUnit gml:id="MTR">
   <description>The fundamental unit of length in the metric system.
Note: The specific meaning is determined by the appropriate associated
quantity.</description>
   <identifier
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    MTR
   </identifier>
   <name
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    Metre
   </name>
   <quantityType>Length</quantityType>
   <catalogSymbol
    codeSpace="http://www.bipm.org/en/si/base_units">m</catalogSymbol>
   <unitsSystem xlink:href="http://www.bipm.fr/en/si"/>
  </BaseUnit>
 </dictionaryEntry>
 <dictionaryEntry>
  <BaseUnit gml:id="SEC">
   <description>The fundamental unit of time in the metric system. Note:
The specific meaning is determined by the appropriate associated
quantity.</description>
   <identifier
     codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
     SEC
   </identifier>
   <name
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    Second
   </name>
   <quantityType>Time</quantityType>
   <catalogSymbol
    codeSpace="http://www.bipm.org/en/si/base_units">s</catalogSymbol>
   <unitsSystem xlink:href="http://www.bipm.fr/en/si"/>
  </BaseUnit>
 </dictionaryEntry>
 <!-- ... -->
 <dictionaryEntry>
  <DerivedUnit gml:id="MTS">
```

```
   <description>The derived unit of speed in the metric system. Note:
The specific meaning is determined by the appropriate associated
quantity.</description>
   <identifier
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    MTS
   </identifier>
   <name
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    Metres per Second
   </name>
   <quantityType>Speed</quantityType>
   <catalogSymbol
    codeSpace="http://www.bipm.fr/en/si">m/s</catalogSymbol>
   <derivationUnitTerm uom="#MTR" exponent="1"/>
   <derivationUnitTerm uom="#SEC" exponent="-1"/>
  </DerivedUnit>
 </dictionaryEntry>
 <dictionaryEntry>
  <DerivedUnit gml:id="C81">
   <description>The supplemental unit of plane angle in the metric
system. Note: The specific meaning is determined by the appropriate
associated quantity.</description>
   <identifier
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    C81
   </identifier>
   <name
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    Radian
   </name>
   <quantityType>Plane angle</quantityType>
   <catalogSymbol
    codeSpace="http://www.bipm.fr/en/si">rad</catalogSymbol>
   <derivationUnitTerm uom="#MTR" exponent="1"/>
   <derivationUnitTerm uom="#MTR" exponent="-1"/>
  </DerivedUnit>
 </dictionaryEntry>
 <!-- ... -->
 <dictionaryEntry>
  <ConventionalUnit gml:id="cm">
   <identifier
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    centiMTR
   </identifier>
   <name
    codeSpace="https://www.dgiwg.org/FAD/registers.jsp?register=DTD">
    centiMetre
   </name>
   <quantityType>Length</quantityType>
   <catalogSymbol
    codeSpace="http://www.bipm.org/en/si/base_units">m</catalogSymbol>
   <conversionToPreferredUnit uom="#MTR">
    <factor>0.01</factor>
   </conversionToPreferredUnit>
  </ConventionalUnit>
```

```
 </dictionaryEntry>
 <!-- ... -->
</Dictionary>
```

8 GML Application Schema

8.1 Overview

The GML Application Schema is automatically derived from the UML application schema using the ShapeChange UGAS (UML-to-GML-Application-Schema conversion) tool. This can be done in two ways. First, by using the command line interface which requires that the UML model is already available. A second method uses the web interface and its integrated Catalog Service client by discovering a previously unknown model by querying a registry.

8.2 Using the ShapeChange command line interface

After exporting the UML model as an XMI 1.0 file, e.g., "gsip_v1.8.xml", the ShapeChange tool is executed with the following parameters:

```
java -Xms512m -Xmx1424m -jar ShapeChange.jar -M "DDMS" –A "NSGFC"
–D "TYPE" -v "3.2" -o "GSIP" "gsip_v1.8.xml"
```

See the ShapeChange documentation (available at http://www.interactive-instruments.de/ShapeChange/) for details about the parameters.

NOTE The Rational Rose UML model of GSIP v1.8 has a file size of ca. 85 MB. The exported XMI file has a file size of ca. 400 MB (the export from Rational Rose took 30 hours on a notebook). The resulting GML application schema has a file size of ca.37 MB of which ca. 19 MB are schema metadata (the processing of the XMI file by ShapeChange took 12 hours).

As a result of the operation, the GML application schema and its XML Schema documents are created (as well as schema metadata and GML dictionaries for the definitions in the application schema).

In this process ShapeChange reports some warnings which refer to model elements from the ISO 19100 model and not from the NSG Feature Catalog.

The GML application schema should be verified after creation with appropriate tools. In OWS-4 this has been done with Xerces-J.

8.3 Using the ShapeChange web interface and Catalog Service client

This alternative path uses the same approach as in the previous subclause, however, the steps are exectuted using a graphical, web browser-based user interface.

In addition, UML models published in Catalog Service registries following the guidelines for schema metadata specified in Clause 9 can be discovered through that interface. After the GML application schema has been created, the document is uploaded to a http-accesible ftp repository and the newly created schema can be published in a Catalog Service registry following the guidelines for schema metadata.

See the ShapeChange documentation for details about using the web interface and the Catalog Service client.

8.4 Use of tagged values in the encoding

In general, GML 3.2 allows for control of how some elements are to be represented in GML / XML Schema. There are a number of tagged values for this that have been introduced above:

- For classes:
    - documentation: Used for the textual description of the class.
    - noPropertyType: “true” suppresses the creation of a property type in GML (usually should be set only if the class is never a value of another property or only references are used to represent associations between objects – see below). No action required.
    - byValuePropertyType: “true” creates an additional property type that enforces that the object is encoded inline in the property in the XML instances. It is not expected that this applies for the GSIP. No action required.
    - isCollection: "true" identifies a class as an object collection – note that this information is on the type level.
    - asDictionary (only <<CodeList>>): “true” encodes a value as a reference to an external dictionary instead of fixing the values in the schema. Currently not relevant, but see below.
- For properties (attributes and association ends):
    - documentation: Used for the textual description of the class.
    - sequenceNumber: Unique value used to enforce that the order of properties in the XML Schema is invariant over several runs of the UML-to-GML process, because properties in UML are unordered.
    - inlineOrByReference: The typical pattern for object-valued properties in GML is that the target object can either be embedded inline in the XML element of the property or referenced by use of Xlink. Application schemas may restrict this to either “inline” (no use of Xlink) or

"byReference" (no inline encoding, always Xlinks are used for feature associations). Examples of the different encoding styles:

The encoding using "byReference" is:

```
<FeatureCollection>
 <member>
  <ExtractionMine gml:id="o1">
   <isLocatedInCountry xlink:href="#o2"/>
  </ExtractionMine>
 </member>
 <member>
  <GeopoliticalCountry gml:id="o2">
   <isLocationCountryOf xlink:href="#o1"/>
  </GeopoliticalCountry>
 </member>
</FeatureCollection>
```

The encoding using "inline" would be as follows:

```
<FeatureCollection>
 <member>
  <ExtractionMine gml:id="o1">
   <isLocatedInCountry>
    <GeopoliticalCountry gml:id="o2">
     <isLocationCountryOf>
      <!-- ExtractionMine is already encoded in the
      document and cannot be copied here again! -->
     </isLocationCountryOf>
    </GeopoliticalCountry>
   </isLocatedInCountry>
  </ExtractionMine>
 </member>
</FeatureCollection>
```

The default (if neither "inline" or "byReference" is specified in the two association roles) would allow any of the following encodings:

```
<FeatureCollection>
 <member>
  <ExtractionMine gml:id="o1">
   <isLocatedInCountry>
    <GeopoliticalCountry gml:id="o2">
     <isLocationCountryOf xlink:href="#o1"/>
    </GeopoliticalCountry>
   </isLocatedInCountry>
  </ExtractionMine>
 </member>
</FeatureCollection>

or

<FeatureCollection>
 <member>
```

```
  <GeopoliticalCountry gml:id="o2">
   <isLocationCountryOf>
    <ExtractionMine gml:id="o1">
     <isLocatedInCountry xlink:href="#o2"/>
    </ExtractionMine>
   </isLocationCountryOf>
  </GeopoliticalCountry>
 </member>
</FeatureCollection>

or

<FeatureCollection>
 <member>
  <ExtractionMine gml:id="o1">
   <isLocatedInCountry xlink:href="#o2"/>
  </ExtractionMine>
 </member>
 <member>
  <GeopoliticalCountry gml:id="o2">
   <isLocationCountryOf xlink:href="#o1"/>
  </GeopoliticalCountry>
 </member>
</FeatureCollection>
```

For GSIP application schemas, the following rules apply:

- Every property that has an object as its value that is not a feature shall have the object embedded inline. The only exception is when an object occurs multiple times in an XML document when the first occurance shall be embedded inline and the other instances shall be referenced using a bare name Xpointer referencing the gml:id value in the same document (e.g., xlink:href="#fe_132"). Therefore, the value has to be neither "inline" or "byReference"). Note that this approach has been taken due to limitations in the Web Feature Services which only provides limited support for objects that are not features. If these will be resolved in the future, "byReference" would be used instead.
- Every property that has a feature as its value shall not embed the feature inline, but used a xlink:href reference ("byReference").

o isMetadata: “true” for those properties whose value is considered metadata, e.g. all properties whose value type is a type specified in ISO 19115.

8.5 Additional encoding rules

8.5.1 General remarks

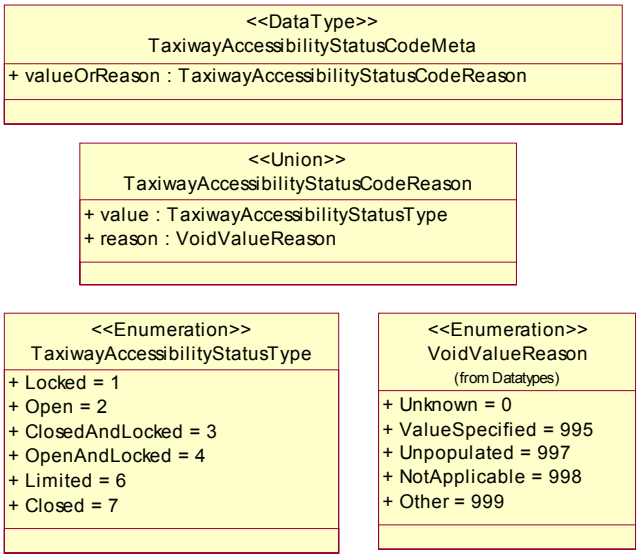
This subclause specifies additional encoding rules in addition to GML Annex E.

8.5.2 nillable, nilReasonAllowed and implementedByNilReason

If an attribute has a tagged value "nillable" with value "true", the property element would be defined with "nillable" set to "true".

If a type has a tagged value "nilReasonAllowed" with value "true", all property types for this property would be defined with an optional nilReason attribute.

If a property of the conceptual model is implemented by the nilReason concept of GML, the tagged value “implementedByNilReason” is set. As a result, the following classes



are encoded in the GML application schema as

```
    <element name="TaxiwayAccessibilityStatusCodeMeta"
        type="gsip:TaxiwayAccessibilityStatusCodeMetaType" substitutionGroup="gsip:DatatypeMeta"/>

    <complexType name="TaxiwayAccessibilityStatusCodeMetaType">
        <annotation>
            <documentation>Taxiway Accessibility Status Code or Reason; with Metadata: A coded domain value
denoting the accessibility status type of a taxiway, accompanied by the reason that the value may be absent and
associated metadata.</documentation>
            <appinfo>
                <sc:taggedValue tag="primaryCode">TaxiwayAccessibilityStatusCodeMeta</sc:taggedValue>
            </appinfo>
        </annotation>
        <complexContent>
            <extension base="gsip:DatatypeMetaType">
                <sequence>
                    <element name="valueOrReason" nillable="true">
                        <annotation>
                            <documentation>Taxiway Accessibility Status Code Value: A taxiway accessibility
status code value.</documentation>
                            <appinfo>
                                <sc:taggedValue tag="primaryCode">value</sc:taggedValue>
                            </appinfo>
                        </annotation>
                        <complexType>
```

```
                        <simpleContent>
                            <extension base="gsip:TaxiwayAccessibilityStatusTypeType">
                                <attribute name="nilReason" type="gml:NilReasonType"/>
                            </extension>
                        </simpleContent>
                    </complexType>
                </element>
            </sequence>
        </extension>
    </complexContent>
</complexType>

<complexType name="TaxiwayAccessibilityStatusCodeMetaPropertyType">
    <sequence>
        <element ref="gsip:TaxiwayAccessibilityStatusCodeMeta"/>
    </sequence>
</complexType>

<simpleType name="TaxiwayAccessibilityStatusTypeType">
    <annotation>
        <documentation>Taxiway Accessibility Status Type: A coded domain value denoting the accessibility
status type of a taxiway.</documentation>
        <appinfo>
            <sc:taggedValue tag="primaryCode">TaxiwayAccessibilityStatusType</sc:taggedValue>
        </appinfo>
    </annotation>
    <restriction base="string">
        <enumeration value="1">
            <annotation>
                <documentation>Locked: Access is prevented by a physical barrier, requiring special means to
pass (for example: a key).</documentation>
                <appinfo>
                    <sc:taggedValue tag="primaryCode">Locked</sc:taggedValue>
                    <sc:taggedValue tag="secondaryCode">1</sc:taggedValue>
                </appinfo>
            </annotation>
        </enumeration>
        <enumeration value="2">
            <annotation>
                <documentation>Open: Access is officially allowed. [desc] May be covered and/or blocked by
a physical barrier that is temporarily passable.</documentation>
                <appinfo>
                    <sc:taggedValue tag="primaryCode">Open</sc:taggedValue>
                    <sc:taggedValue tag="secondaryCode">2</sc:taggedValue>
                </appinfo>
            </annotation>
        </enumeration>
        <enumeration value="3">
            <annotation>
                <documentation>Locked Closed: Access is officially prohibited and is restricted by a physical
barrier, requiring special means to pass (for example: a key).</documentation>
                <appinfo>
                    <sc:taggedValue tag="primaryCode">ClosedAndLocked</sc:taggedValue>
                    <sc:taggedValue tag="secondaryCode">3</sc:taggedValue>
                </appinfo>
            </annotation>
        </enumeration>
        <enumeration value="4">
            <annotation>
                <documentation>Locked Open: Access is officially allowed although restricted by a physical
barrier that is currently open, requiring special means to close and prevent future passage (for example: a
key).</documentation>
                <appinfo>
                    <sc:taggedValue tag="primaryCode">OpenAndLocked</sc:taggedValue>
                    <sc:taggedValue tag="secondaryCode">4</sc:taggedValue>
```

```
                    </appinfo>
                </annotation>
            </enumeration>
            <enumeration value="6">
                <annotation>
                    <documentation>Limited: A limitation on access, but not function, has been imposed. [desc]
Not necessarily enforced by a physical barrier.</documentation>
                    <appinfo>
                        <sc:taggedValue tag="primaryCode">Limited</sc:taggedValue>
                        <sc:taggedValue tag="secondaryCode">6</sc:taggedValue>
                    </appinfo>
                </annotation>
            </enumeration>
            <enumeration value="7">
                <annotation>
                    <documentation>Closed: Access is officially prohibited. [desc] May be covered and/or blocked
by a physical barrier.</documentation>
                    <appinfo>
                        <sc:taggedValue tag="primaryCode">Closed</sc:taggedValue>
                        <sc:taggedValue tag="secondaryCode">7</sc:taggedValue>
                    </appinfo>
                </annotation>
            </enumeration>
        </restriction>
    </simpleType>
```

8.5.3 asGroup

If a <<Union>> class has a tagged value “asGroup” with a value “true” then it is encoded as a global group which is referenced wherever a property is defined that has the union class as its value. Note that this is only valid if from the context it is clear how to map the individual values to the conceptual model.

8.5.4 Mixin classes

Due to the fact that several implementation platforms including XML Schema supports only type derivation from a single base type (element substitutablity in XML Schema is restricted to a single element, too), the use of multiple inheritance is currently not supported by GML 3.2 Annex E.

However, for conceptual modelling, the ability to define abstract types which capture a set of properties that are associated with a concept is sometimes very convenient.

The following additional rules for such abstract types are therefore supported by ShapeChange:

If a class is a specialization of another class, then this class shall have one of the stereotypes <<FeatureType>>, <<DataType>>, no stereotype or <<Type>>.

The class shall have zero or one supertype with the same stereotype and zero or more abstract supertypes of the stereotype <<Type>>.

I.e., disregarding classes with stereotype <<Type>>, a generalization relationship shall be specified only between two classes that are either:

- *both feature types (stereotype <<FeatureType>>),*
- *both object types (no stereotype), or*
- *both data types (stereotype <<DataType>>).*

For every class <<Type>> all direct or indirect subtypes shall be either

- *all feature or object types (stereotypes <<FeatureType>>, no stereotype or <<Type>>),*
- *all data types (stereotypes <<DataType>> or <<Type>>).*

All generalization relationships between classes shall have no stereotype. The discriminator property of the UML generalization shall be blank.

The abstract mixin class (example in the GSIP: GeometryInfo) is encoded as a group with all properties (attributes and navigable association ends) encoded as usual. This group will be referenced from the subtype.

EXAMPLE GeometryInfo and PointGeometryInfo:

```
  <group name="GeometryInfoGroup">
    <annotation>
      <documentation>Geometry Information: An abstract modeling entity serving as a
superclass that collects shared properties (attributes and associations) of modeling
entities that specify geometric representation information about a feature. [desc] For
example, the horizontal and/or vertical metadata, notes, and/or restriction(s) and/or
security control(s) applicable to dissemination of data regarding the geometric
representation of the feature. [constraint] There exists an associated: Event Entity or
Feature Entity</documentation>
      <appinfo>
        <sc:taggedValue tag="primaryCode">GeometryInfo</sc:taggedValue>
        <sc:taggedValue tag="secondaryCode">ZI029</sc:taggedValue>
        <sc:taggedValue tag="oclExpressions">inv: self.eventEntity-&gt;notEmpty() or
self.featureEntity-&gt;notEmpty()</sc:taggedValue>
      </appinfo>
    </annotation>
    <sequence>
      <element maxOccurs="unbounded" minOccurs="0" name="eventEntity"
       type="gml:ReferenceType">
        <annotation>
          <documentation>Geometry of Event Entity: An event for which this geometry
representation applies.</documentation>
          <appinfo>
            <targetElement xmlns="http://www.opengis.net/gml/3.2">
             gsip:EventEntity
            </targetElement>
            <reversePropertyName xmlns="http://www.opengis.net/gml/3.2">
             gsip:geometry
            </reversePropertyName>
            <sc:taggedValue tag="primaryCode">eventEntity</sc:taggedValue>
          </appinfo>
        </annotation>
      </element>
      <element maxOccurs="unbounded" minOccurs="0" name="featureEntity"
       type="gml:ReferenceType">
        <annotation>
          <documentation>Geometry of Feature Entity: A feature entity for which this
geometry representation applies.</documentation>
          <appinfo>
```



```
            <targetElement xmlns="http://www.opengis.net/gml/3.2">
             gsip:FeatureEntity
            </targetElement>
            <reversePropertyName xmlns="http://www.opengis.net/gml/3.2">
             gsip:geometry
            </reversePropertyName>
            <sc:taggedValue tag="primaryCode">featureEntity</sc:taggedValue>
          </appinfo>
        </annotation>
      </element>
      <element name="horizontalCoordMetadata" type="gml:ReferenceType">
        <annotation>
          <documentation>Horizontal Coordinate Metadata: The horizontal coordinate
metadata of this geometry.</documentation>
          <appinfo>
            <targetElement xmlns="http://www.opengis.net/gml/3.2">
             gsip:HorizCoordMetadata
            </targetElement>
            <reversePropertyName xmlns="http://www.opengis.net/gml/3.2">
             gsip:geometryInfo
            </reversePropertyName>
            <sc:taggedValue tag="primaryCode">horizontalCoordMetadata</sc:taggedValue>
          </appinfo>
        </annotation>
      </element>
      <!-- ... -->
    </sequence>
  </group>

  <element name="PointGeometryInfo" substitutionGroup="gml:Point"
   type="gsip:PointGeometryInfoType"/>
  <complexType name="PointGeometryInfoType">
    <annotation>
      <documentation>Point Geometry Information: A modeling entity collecting geometric
representation information about a feature that is modeled as a spatial point. [desc] A
spatial point is a 0-dimensional geometric primitive, representing a
position.</documentation>
      <appinfo>
        <sc:taggedValue tag="primaryCode">PointGeometryInfo</sc:taggedValue>
        <sc:taggedValue tag="secondaryCode">ZI007</sc:taggedValue>
        <sc:taggedValue tag="oclExpressions">
        </sc:taggedValue>
      </appinfo>
    </annotation>
    <complexContent>
      <extension base="gml:PointType">
        <sequence>
          <group ref="gsip:GeometryInfoGroup"/>
          <!-- ... -->
        </sequence>
      </extension>
    </complexContent>
  </complexType>
```

8.6 Profile of ISO 19107

The spatial schema to be used in connecion with NSG Feature Catalog feature types is restricted to the profile described by the DGIWG/TSMAD Profile of ISO 19107.

Note that this profile does not include geometric aggregates, therefore, in the application schema the data type of spatial geometries are in general specified as "Set<GM_(Orientable)XYZ>" instead of "GM_MultiXYZ".

However, such sets are not specified in the GSIP. In general, GSIP currently uses only

GM_Point, GM_Curve and GM_Surface. It does not specify which interpolation types are supported or required.

8.7 GML Profile

A GML Profile[1] was specified reflecting the current usage of base types from the ISO 19100 series and to be used in conjunction with the application schemas described in this document.

The resulting GML profile is captured in the schema document "gmlNSGProfile.xsd". It is restricted to the GML schema components that are required by the GML application schemas in this IPR.

All deprecated schema components were removed from the profile.

Note that the GML profile and the rules for GSIP-based application schemas do not conform to the GML Simple Feature profile (GML-SF) level 2:

- GML 3.2.1 is used, not GML 3.1.1.
- Geometries with non-linear interpolation are allowed.

Compared to GML Simple Feature level 1, the following additional capabilities are not supported:

- GML objects are required by GSIP,
- nillable and nilReason are required by GSIP,
- multiple level of nesting data types are required by GSIP,
- the use of ISO/TS 19139 is required by GSIP.

NOTE There are probably more capabilities, but the ones noted above are the major ones.

---

[1] Since the GML schema offers a wide range of components that may be used by geospatial application schemas, almost all application schemas will use only a very limited part of the full GML schema. To specify and document the usage of GML by an application schema typically a profile of the GML schema is created and used instead of the full schema.

8.8 Profiling ISO 19115 / ISO/TS 19139

The GML profiling mechanism allows to tailor the GML schema to he specific needs of a community, similar requirements exist for metadata. This section discusses how the metadata schema from ISO 19115 and in particular its encoding based on ISO/TS 19139 can be profiled. ISO/TS 19139 distinguishes extensions and restrictions.

Restrictions:

ISO/TS 19139 acknoledges in A.4 that "there are certain cases when it is desirable to restrict an existing XML Schema." The conformance clause states that user profile restrictions should use annotations in UML to express the restricting constraints (this implies OCL constraints) and enforce these constraints via a tool other than an XML Schema validator.

One option would be Schematron constraints, however, no rules have been specified how OCL constraints could be mapped to Schematron constraints, so the Schematron constraints would need to be added along with the OCL constraints, e.g. in tagged values, if the Schematron constraints should be derived automatically from the UML model.

I.e. ISO/TS 19139 profiles are not directly reflected in XML Schema documents.

The above statements are made in the annex stating the conformance tests. Note that the word "should" indicates in principle that this is just a recommendation although since they are made in the annex discussing conformance this may also be an error in the choice of words. It is probably safer to not create a "profiled" version of the ISO/TS 19139 schema documents.

Extensions:

ISO/TS 19139 uses the word "extension" in the sense that additional classes are being specified in UML. Note that this may lead to restrictions in the domain of values, e.g. in the example of specifying a code list instead of a free text, for example, when limiting the property metadataStandardName in MD_Metadata from a free text string to a list of allowed values.

Based on ISO 19115 the allowed extension mechanisms are discussed below. The following discussion assumes that an automated translation from UML to XML Schema is intended. As a result, an amended version of the UGAS tool (or a separate tool) would need the capability to identify metadata classes/packages and apply the 19139 encoding rules instead of the 19136 encoding rules.

- Adding a new metadata section: To be modelled as a new package and associated with its own namespace.
- Creating a new metadata codelist to replace the domain of an existing metadata element that has “free text” listed as its domain value: To be modelled as a <<CodeList>> class and encode these as described in ISO/TS 19139 8.5.5. This puts the element representing an instance in the substitution group of

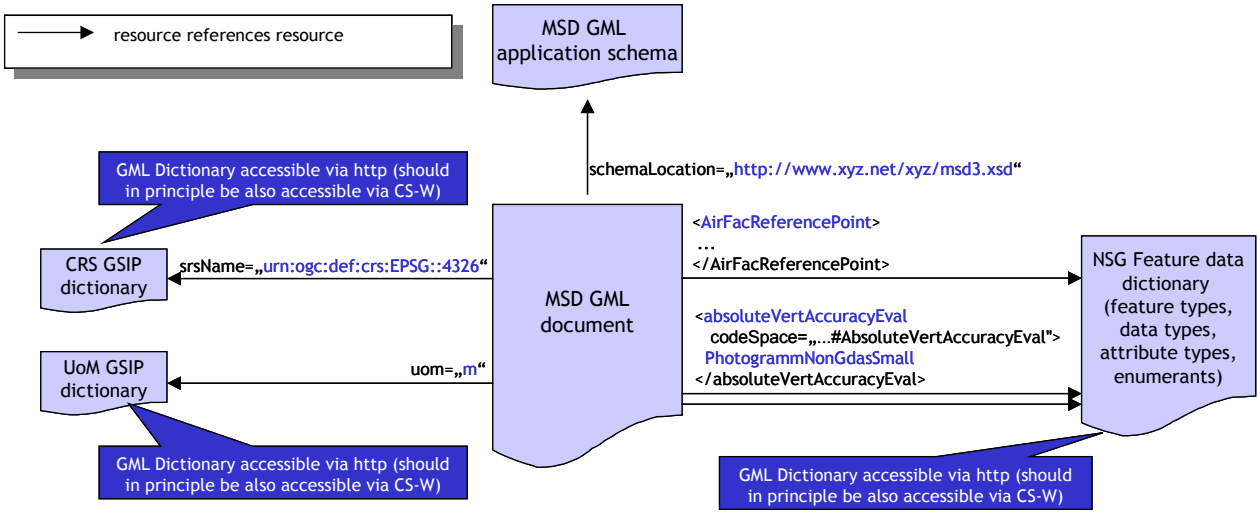
gco:CharacterString. The result of this is that it can appear everywhere where a string is expected and not only as a value of the property for which it was intended. I.e. this extension/restriction has no impact on XML Schema validation and this constraint must be checked by the application.

- Creating new metadata codelist elements (expanding a codelist): To be handled in the registry - no impact on schemas in UML or GML.
- Adding a new metadata element: A new subtype of the metadata class that is to be extended needs to be defined in a new namespace (might be the application schema namespace or a different one - this has to be controlled by the use of packages). In the new type new properties (metadata elements) can be created.
- Adding a new metadata entity: A new type is modelled in UML. It *somehow* needs to be identifyable as a metadata entity so that the appropriate encoding rules can be applied.

This topic is discussed in several communities. Simon Cox has documented some of the conclusions of related discussions in his Wiki (see https://www.seegrid.csiro.au/twiki/bin/view/AppSchemas/MetadataProfiles).

8.9 References from GML instance documents

The figure below illustrates references from GML instances to other items of geographic information, typically maintained in registers:



8.10 OWS-4 Application Schemas

The following application schemas were created in OWS-4:

- GSIP v1.8 (draft)
- LocalMSD

NOTE In addition, DAFIF Ed. 9 application schema was created, which was not based on GSIP.

9 Schema metadata

9.1 Overview

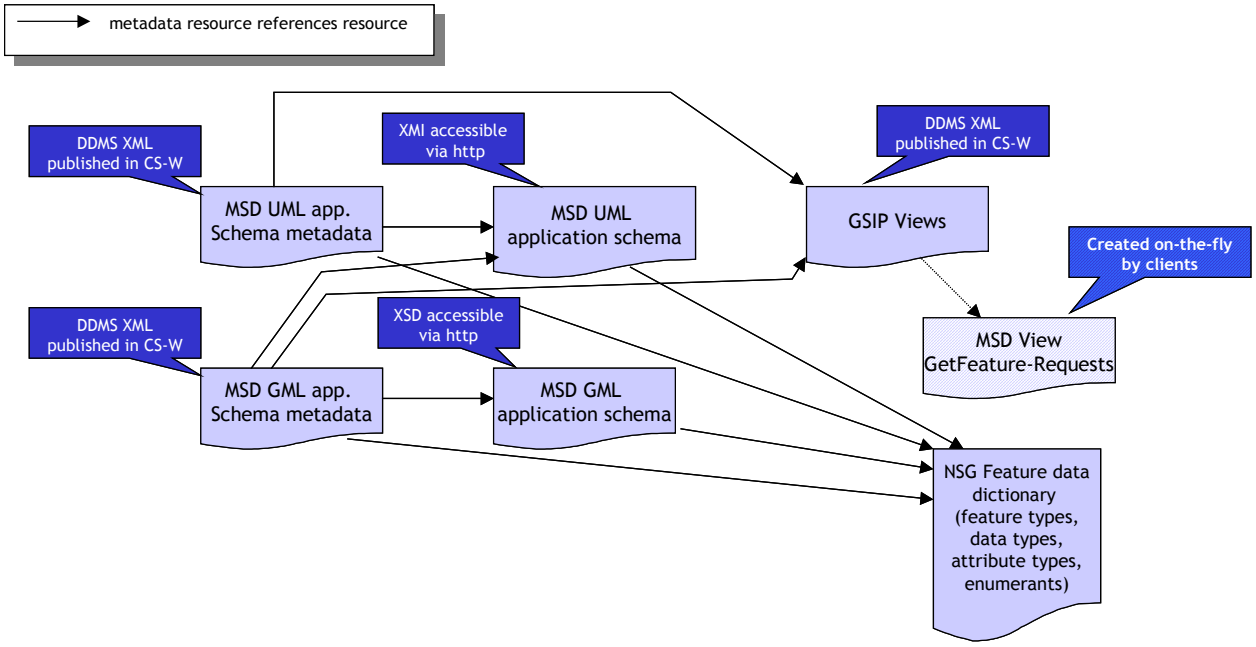
9.1.1 Base specifications

DDMS 1.3 is the mandatory specification for discovery metadata in NGA.

CS-W 2.0.1 is the specifciation used to access metadata. The metadata will be specified on the basis of the core queryable properties and additional queryable properties. These have been mapped to ebRIM representations by the OWS-4 participants providing the Catalog Services (see OGC document 06-155, OWS-4 CSW ebRIM Modelling Guidelines IPR).

9.1.2 Resource types for application schemas in OWS-4

- Application schema
- Feature type
- Property type (attributes and association ends)
- View



9.2 Resource "Application Schema"

9.2.1 Overview

Every application schema is described by one DDMS metadata resource.

In most cases, schema metadata that cannot be derived from the model itself will be represented in the UML model using the tagged value extension mechanism of UML. Depending on the resource, the tagged value is associated with the UML package that represents the application schema (packages with stereotype <<Application Schema>>).

If a tagged value contains a set or list of values, then this collection is encoded by a space-seperated list of all elements unless otherwise noted.

9.2.2 Subject

9.2.2.1 CS-W property

Subject (Core queryable property)

9.2.2.2 DDMS primary category

Subject (Mandatory)

9.2.2.3 Representation in the UML application schema

Three pairs of tagged values are used to represent this information:

- Tagged value "TopicCategory": The content shall be the set of all entries in the tagged value of the same name for the feature types of that application schema.
- Tagged value "TopicCategoryNamespace": Namespace of the classification / controlled vocabulary of the terms used in "TopicCategory". Default value is "http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode". The default value should *not* be changed.
- Tagged value "Views": The content shall be the set of all entries in the tagged value of the same name for the in the feature types of that application schema.
- Tagged value "ViewsNamespace": Namespace of the classification / controlled vocabulary of the terms used in "Views". The value is for the GSIP views (which is the vocabulary used in all GSIP-based application schemas) is "http://www.nga.mil/gsip/classification/Views".
- Tagged value "SubjectOther": The content shall be the name of the data content standard, i.e. in OWS-4 one of "GSIP", "GlobalMSD", "RegionalMSD", "LocalMSD", "UrbanMSD", "DAFIF", "DVOF", or "SAC".
- Tagged value "SubjectOtherNamespace": Namespace of the classification / controlled vocabulary of the terms used in "SubjectOther". In OWS-4, this

element is used to store the abbreviated name of the data content standards with the namespace "http://www.nga.mil/gsip/classification/DataContentStandards".

Note: the URIs need to be reviewed and are subject to change.

9.2.2.4 Representation in DDMS (schema metadata)

For each of the three tagged values a classification shall be established in the catalog. The three classifications shall be maintained seperately in the Catalogue Service. The namespace qualifiers distinguish between the three vocabularies.

In DDMS, all values of the three classifications that are associated with the resource shall be encoded as ddms:category elements with the appropriate namespace.

9.2.3 Title

9.2.3.1 CS-W property

Title (Core queryable property)

9.2.3.2 DDMS primary category

Title (Mandatory)

9.2.3.3 Representation in the UML application schema

Tagged value "Title". The value shall be identical to the name of the package.

Tagged value "Subtitle". The value shall be the concatenation of "Version " and the version qualifier.

9.2.3.4 Representation in DDMS (schema metadata)

Value of tagged values "Title" (ddms:title) and "Subtitle" (ddms:subtitle).

9.2.4 Abstract

9.2.4.1 CS-W property

Abstract (Core queryable property)

9.2.4.2 DDMS primary category

Description (Optional)

9.2.4.3 Representation in the UML application schema

Tagged value "documentation" (pre-defined in the UML specification): Concatenation of

- the name of the application schema

- ": "
- the definition of the application schema
- " [desc] " (only if the description exists)
- the description of the application schema (only if the description exists)

9.2.4.4 Representation in DDMS (schema metadata)

Value of tagged value "documentation" (in element ddms:description), but

- the name and ": " at the beginning are removed
- "[desc]" is replaced by "Additional description:"

9.2.5 Any Text

Not used

9.2.6 Format

9.2.6.1 CS-W property

Format (Core queryable property)

9.2.6.2 DDMS primary category

Format (Optional)

9.2.6.3 Representation in the UML application schema

Not applicable.

9.2.6.4 Representation in DDMS (schema metadata)

ddms:mimeType values are one of

- 'text/xml; subtype="xmi/1.0"': This value is used for a UML model that does not follow the rules specified by ISO 19109 and/or ISO 19136
- 'text/xml; subtype="xmi/1.0/iso19109"': This value is used for a UML application schema that follows the rules specified by ISO 19109, but not the stricter rules specified by ISO 19136 Annex E
- 'text/xml; subtype="xmi/1.0/iso19136"': This value is used for a UML application schema that does follow the rules specified by ISO 19136 Annex E

In OWS-4 all application schemas will be schemas of mime type 'text/xml; subtype="xmi/1.0/iso19136"' or 'text/xml; subtype="xmi/1.0/iso19109"'.

For GML, the code list of known values is:

- text/xml; subtype="gmlas/2.1"
- text/xml; subtype="gmlas/3.1"
- text/xml; subtype="gmlas/3.1/sfgml"
- text/xml; subtype="gmlas/3.2"

ddms:medium is always "digital".

9.2.7 Identifier

9.2.7.1 CS-W property

Identifier (Core queryable property)

9.2.7.2 DDMS primary category

Identifier (Mandatory)

9.2.7.3 Representation in the UML application schema

Tagged value "Identifier". It is strongly recommended to use a URN (see IETF RFC 2141).

9.2.7.4 Representation in DDMS (schema metadata)

Value of tagged value "Identifier" (ddms:identifier with ddms:qualifier="URN").

9.2.8 Modified

9.2.8.1 CS-W property

Modified (Core queryable property)

9.2.8.2 DDMS primary category

Date (Optional)

9.2.8.3 Representation in the UML application schema

Tagged value "Modified": The content shall be specified as "YYYY-MM-DD".

9.2.8.4 Representation in DDMS (schema metadata)

Value of tagged value "Modified" (attribute ddms:created of ddms:dates).

9.2.9 Type

9.2.9.1 CS-W property

Type (Core queryable property)

9.2.9.2 DDMS primary category

Type (Optional)

9.2.9.3 Representation in the UML application schema

Not applicable

9.2.9.4 Representation in DDMS (schema metadata)

Attribute ddms:value of ddms:type is always "Schema".

9.2.10 Bounding Box

Not used.

Note: The relevant DDMS primary categories are Geospatial Coverage and Temporal Coverage.

9.2.11 CRS

Not used.

9.2.12 Association

9.2.12.1 CS-W property

Association (Core queryable property)

The following associations are used:

- derivedFrom: *UML application schema* is derived from *Feature Catalog*
- dependsOn: *UML application schema* depends on *UML application schema*
- resource: *UML application schema* is available at *URL*

9.2.12.2 DDMS primary category

Not described by DDMS, extension required.

9.2.12.3 Representation in the UML application schema

The following associations are used:

- derivedFrom: (not represented)
- dependsOn: UML dependency relationsships between packages representing application schemas
- resource: (not represented)

9.2.12.4 Representation in DDMS (schema metadata)

relations/relation elements (preliminary namespace "http://www.opengis.net/ows4/schemametadata") with values "derivedFrom", "dependsOn" or "resource".

attribute xlink:href of relation element is

- derivedFrom: URI representing the feature catalog
- dependsOn: the tagged value "Identifier" of the target application schema package
- resource: URL of the XMI document containing the application schema

9.2.13 Security

9.2.13.1 CS-W property

Security (Additional queryable property)

9.2.13.2 DDMS primary category

Security (Mandatory)

9.2.13.3 Representation in the UML application schema

Tagged values:

- IC:classification
- IC:ownerProducer
- IC:SCIcontrols
- IC:SARIdentifier
- IC:disseminationControls
- IC:FGIsourceOpen
- IC:FGIsourceProtected
- IC:releasableTo
- IC:nonICmarkings

- IC:classifiedBy
- IC:classificationReason
- IC:derivedFrom
- IC:declassDate
- IC:declassEvent
- IC:declassException
- IC:typeOfExemptedSource
- IC:dateOfExemptedSource
- IC:declassManualReview

9.2.13.4 Representation in DDMS (schema metadata)

The taged values are used to populate XML attribute instances of the following XML Schema definitions from the Intelligence Community Information Security Marking (IC ISM) Version 2.0 as the authoritative implementation of CAPCO:

- urn:us:gov:ic:ism:v2:SecurityAttributesOptionGroup

The values therefore shall conform to the rules of this specification.

The value of "IC:classification" shall be stored in the Catalogue Service as a classification. The allowed values for this classification by IC ISM are:

- U
- C
- S
- TS
- R
- CTS
- CTS-B
- CTS-BALK
- NU
- NR
- NC

- NS
- NS-S
- NS-A
- CTSA
- NSAT
- NCA

9.2.14 Creator

9.2.14.1 CS-W property

Creator (Additional queryable property)

9.2.14.2 DDMS primary category

Creator (Mandatory)

9.2.14.3 Representation in the UML application schema

Tagged Values "CreatorName" (name of the organisation), "CreatorPhone" (phone number of the organisation) and "CreatorEmail" (email address of the organisation).

9.2.14.4 Representation in DDMS (schema metadata)

According to the values of the tagged values (child elements ddms:name, ddms:phone and ddms:email of ddms:creator/ddms:Organization).

9.2.15 Publisher

9.2.15.1 CS-W property

Publisher (Additional queryable property)

9.2.15.2 DDMS primary category

Publisher (Optional)

9.2.15.3 Representation in the UML application schema

Tagged Values "PublisherName" (name of the organisation), "PublisherPhone" (phone number of the organisation) and "PublisherEmail" (email address of the organisation).

These will be fixed values for all NGA application schemas.

9.2.15.4 Representation in DDMS (schema metadata)

According to the values of the tagged values (child elements ddms:name, ddms:phone and ddms:email of ddms:publisher/ddms:Organization).

9.2.16 Other DDMS elements with fixed values

An element ddms:language with attribute ddms:qualifier and value "ISO 639-1" and attribute ddms:value with value "en" is part of the DDMS resource element.

An element ddms:rights with attribute ddms:copyright and value "true" is part of the DDMS resource element.

9.2.17 DDMS XML example

```
  <Resource xmlns="http://metadata.dod.mil/mdr/ns/DDMS/1.3/">
    <identifier ddms:qualifier="URN" ddms:value="urn:x-
nsgfc:AS:id:GSIP:1.8"/>
    <title ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">GEOINT Structure Implementation
Profile</title>
    <subtitle ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">Version 1.8</subtitle>
    <description ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">
This application schema defines the conceptual model for identifying and
encoding Geospatial Intelligence (GEOINT)
data in the U.S. National System for Geospatial-Intelligence (NSG).
Additional description: It specifically addresses
selected ISO standards for modeling features and surfaces coverages),
drawing on relevant military standards,
specifications and profiles established by the Digital Geospatial
Information Working Group (DGIWG).</description>
    <language ddms:qualifier="ISO 639-1" ddms:value="en"/>
    <dates ddms:created="2006-08-05"/>
    <rights ddms:copyright="true"/>
    <type ddms:value="Schema"/>
    <creator ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">
      <Organization>
        <name>NGA</name>
        <phone>+1-703-814-4580</phone>
        <email>NCGIS-mail@nga.mil</email>
      </Organization>
    </creator>
    <publisher ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">
      <Organization>
        <name>NGA</name>
        <phone>+1-703-814-4580</phone>
        <email>NCGIS-mail@nga.mil</email>
      </Organization>
    </publisher>
    <format>
      <Media>
```

```
        <mimeType>text/xml; subtype="xmi/1.0/iso19109"</mimeType>
        <extent/>
        <medium>digital</medium>
      </Media>
    </format>
    <subjectCoverage>
      <Subject>
        <category ddms:label="GSIP"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/DataContentStand
ards"/>
        <category ddms:label="inlandWater"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/Views"/>
        <category ddms:label="elevation"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/Views"/>
        <category ddms:label="aeronautical"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/Views"/>
        ...
        <category ddms:label="farming"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="biota"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="boundaries"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="economy"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="elevation"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="environment"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="geoscientificInformation"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="health"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="intelligenceMilitary"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="inlandWaters"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="location"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="oceans"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="society"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="structure"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="transportation"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <category ddms:label="utilitiesCommunication"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
      </Subject>
    </subjectCoverage>
    <security ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency"/>
    <relations xmlns="http://www.opengis.net/ows4/schemametadata">
      <relation xlink:href="urn:x-
nsgfc:FC:id:GSIP:1.8">derivedFrom</relation>
```

```
      <relation xlink:href="http://www.interactive-
instruments.de/ows/repository/xmi/gsip.xml">resource</relation>
    </relations>
  </Resource>
```

9.3 Resource "Feature Type"

9.3.1 Overview

Every feature type in a UML application schema is described by one DDMS metadata resource.

In most cases, schema metadata that cannot be derived from the model itself will be represented in the UML model using the tagged value extension mechanism of UML. In this case, the tagged values are associated with the UML class that represents the feature type (class with stereotype <<FeatureType>>).

If a tagged value contains a set or list of values, then this collection is encoded by a space-seperated list of all elements unless otherwise noted.

9.3.2 Subject

9.3.2.1 CS-W property

Subject (Core queryable property)

9.3.2.2 DDMS primary category

Subject (Mandatory)

9.3.2.3 Representation in the UML application schema

Eight tagged values are used to represent this information:

- Tagged value "TopicCategory": The content shall be the set of all applicable values from the MD_TopicCategoryCode enumeration from ISO 19115, i.e.
    - farming
    - biota
    - boundaries
    - climatologyMeteorologyAtmosphere
    - economy
    - elevation
    - environment

  - geoscientificInformation
  - health
  - imageryBaseMapsEarthCover
  - intelligenceMilitary
  - inlandWaters
  - location
  - oceans
  - planningCadastre
  - society
  - structure
  - transportation
  - utilitiesCommunication

- Tagged value "Views": The content shall be the set of all applicable values from the list of views defined in the GSIP, i.e. those views which are associated with ths feature type.
- Tagged value "SubjectOther": The content shall be the value of the name in the tagged value of the same name for the application schema.
- Tagged value "TopicCategoryNamespace": The content shall be the value of the name in the tagged value of the same name for the application schema.
- Tagged value "ViewsNamespace": The content shall be the value of the name in the tagged value of the same name for the application schema.
- Tagged value "SubjectOtherNamespace": The content shall be the value of the name in the tagged value of the same name for the application schema.
- Tagged value "PrimaryCode": The content shall be the value of the alpha code.
- Tagged value "SecondaryCode": The content shall be the value of the DFDD code.

9.3.2.4 Representation in DDMS (schema metadata)

For each of the first six tagged values see 'Subject' for Application Schema resources.

For the last two tagged values ddms:keyword elements with attributes ddms:value shall be created, the value of the tagged value shall be the value of the attribute.

9.3.3 Title

9.3.3.1 CS-W property

Title (Core queryable property)

9.3.3.2 DDMS primary category

Title (Mandatory)

9.3.3.3 Representation in the UML application schema

Tagged value "Title". The value shall be the name of the feature type.

Tagged value "Subtitle". The value shall be the concatenation of "Version " and the version qualifier of the application schema.

9.3.3.4 Representation in DDMS (schema metadata)

Value of tagged values "Title" (ddms:title) and "Subtitle" (ddms:subtitle).

9.3.4 Abstract

9.3.4.1 CS-W property

Abstract (Core queryable property)

9.3.4.2 DDMS primary category

Description (Optional)

9.3.4.3 Representation in the UML application schema

Tagged value "documentation" (pre-defined in the UML specification): Concatenation of

- the name of the feature type
- ": "
- the definition of the feature type
- " [desc] " (only if the description exists)
- the description of the feature type (only if the description exists)

9.3.4.4 Representation in DDMS (schema metadata)

Value of tagged value "documentation" (in element ddms:description), but

- the name and ": " at the beginning are removed

- "[desc]" is replaced by "Additional description:"

9.3.5 Any Text

Not used

9.3.6 Format

9.3.6.1 CS-W property

Format (Core queryable property)

9.3.6.2 DDMS primary category

Format (Optional)

9.3.6.3 Representation in the UML application schema

Not applicable.

9.3.6.4 Representation in DDMS (schema metadata)

ddms:mimeType values are one of

- 'text/xml; subtype="xmi/1.0"': This value is used for a UML model that does not follow the stricter rules specified by ISO 19109 and/or ISO 19136
- 'text/xml; subtype="xmi/1.0/iso19109"': This value is used for a UML application schema that follows the rules specified by ISO 19109, but not the stricter rules specified by ISO 19136 Annex E
- 'text/xml; subtype="xmi/1.0/iso19136"': This value is used for a UML application schema that does follow the rules specified by ISO 19136 Annex E

In OWS-4 all application schemas will be schemas of mime type 'text/xml; subtype="xmi/1.0/iso19136"' or 'text/xml; subtype="xmi/1.0/iso19109"'.

For GML, the code list of known values is:

- text/xml; subtype="gmlas/2.1"
- text/xml; subtype="gmlas/3.1"
- text/xml; subtype="gmlas/3.1/sfgml"
- text/xml; subtype="gmlas/3.2"

ddms:medium is always "digital".

9.3.7 Identifier

9.3.7.1 CS-W property

Identifier (Core queryable property)

9.3.7.2 DDMS primary category

Identifier (Mandatory)

9.3.7.3 Representation in the UML application schema

Tagged value "Identifier". It is strongly recommended to use a URN (see IETF RFC 2141).

9.3.7.4 Representation in DDMS (schema metadata)

Value of tagged value "Identifier" (ddms:identifier with ddms:qualifier="URN").

9.3.8 Modified

9.3.8.1 CS-W property

Modified (Core queryable property)

9.3.8.2 DDMS primary category

Date (Optional)

9.3.8.3 Representation in the UML application schema

Tagged value "Modified": If provided, the content shall be specified as "YYYY-MM-DD".

9.3.8.4 Representation in DDMS (schema metadata)

Value of tagged value "Modified" (attribute ddms:created of ddms:dates), if provided.

9.3.9 Type

9.3.9.1 CS-W property

Type (Core queryable property)

9.3.9.2 DDMS primary category

Type (Optional)

9.3.9.3 Representation in the UML application schema

Not applicable

9.3.9.4 Representation in DDMS (schema metadata)

Attribute ddms:value of ddms:type is always "FeatureType".

9.3.10 Bounding Box

Not used.

Note: The relevant DDMS primary categories are Geospatial Coverage and Temporal Coverage.

9.3.11 CRS

Not used.

9.3.12 Association

9.3.12.1 CS-W property

Association (Core queryable property)

The following associations are used:

- derivedFrom: *UML Feature type* is derived from *Feature Catalog Feature type*
- partOf: *UML Feature Type* is part of *UML Application schema*
- resource: *UML Feature type* is available at *URL*
- inView: *UML Feature Type* is included in *View*

9.3.12.2 DDMS primary category

Not described by DDMS, extension required.

9.3.12.3 Representation in the UML application schema

The following associations are used:

- derivedFrom: (not represented)
- partOf: (direct or indirect) containment of the feature type class in the package representing the application schema
- resource: (not represented)
- inView: each element in the list in the tagged value "Views" represents one

association

9.3.12.4 Representation in DDMS (schema metadata)

relations/relation elements (preliminary namespace "http://www.opengis.net/ows4/schemametadata") with values "derivedFrom", "partOf", "resource" or "inView".

attribute xlink:href of relation element is

- derivedFrom: a URI representing the feature type in the NSG Feature Catalog, it is recommended to use a URN
- partOf: the tagged value "Identifier" of the application schema package containing the feature type class
- resource: Xpointer to the element representing the feature type class in the XMI document containing the application schema
- inView: a URI representing the view, it is recommended to use a URN; one association per view

9.3.13 Security

9.3.13.1 CS-W property

Security (Additional queryable property)

9.3.13.2 DDMS primary category

Security (Mandatory)

9.3.13.3 Representation in the UML application schema

See 'Security' for Application Schema resources. Typically no tagged value will be provided for feature types. In this case, the value for the application schema apply also to the feature type.

9.3.13.4 Representation in DDMS (schema metadata)

As for Application Schema resources.

9.3.14 Creator

9.3.14.1 CS-W property

Creator (Additional queryable property)

9.3.14.2 DDMS primary category

Creator (Mandatory)

9.3.14.3 Representation in the UML application schema

See 'Creator' for Application Schema resources. Typically no tagged value will be provided for feature types. In this case, the value for the application schema apply also to the feature type.

9.3.14.4 Representation in DDMS (schema metadata)

As for Application Schema resources.

9.3.15 Other DDMS elements with fixed values

An element ddms:language with attribute ddms:qualifier and value "ISO 639-1" and attribute ddms:value with value "en" is part of the DDMS resource element.

An element ddms:rights with attribute ddms:copyright and value "true" is part of the DDMS resource element.

9.3.16 DDMS XML example

```
  <Resource xmlns="http://metadata.dod.mil/mdr/ns/DDMS/1.3/">
    <identifier ddms:qualifier="URN" ddms:value="urn:x-
nsgfc:AS:id:GSIP:1.8:BuiltUpArea"/>
    <title ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">Built-Up Area</title>
    <subtitle ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">Version 1.8</subtitle>
    <description ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">A tract
containing a concentration of buildings and/or other
structures.</description>
    <language ddms:qualifier="ISO 639-1" ddms:value="en"/>
    <dates ddms:created="2006-08-05"/>
    <rights ddms:copyright="true"/>
    <type ddms:value="FeatureType"/>
    <creator ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">
      <Organization>
        <name>NGA</name>
        <phone>+1-703-814-4580</phone>
        <email>NCGIS-mail@nga.mil</email>
      </Organization>
    </creator>
    <format>
      <Media>
        <mimeType>text/xml; subtype="xmi/1.0/iso19109"</mimeType>
        <extent/>
        <medium>digital</medium>
      </Media>
    </format>
```

```
    <subjectCoverage>
      <Subject>
        <category ddms:label="GSIP"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/DataContentStand
ards"/>
        <category ddms:label="Settlements"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/Views"/>
        <category ddms:label="SomeOtherView"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/Views"/>
        <category ddms:label="YetAnotherView"
ddms:qualifier="http://www.nga.mil/nsgfc/classification/Views"/>
        <category ddms:label="structure"
ddms:qualifier="http://www.isotc211.org/2005/gmd/MD_TopicCategoryCode"/>
        <keyword ddms:value="AL015"/>
        <keyword ddms:value="BuiltUpArea"/>
      </Subject>
    </subjectCoverage>
    <security ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency"/>
    <relations xmlns="http://www.opengis.net/ows4/schemametadata">
      <relation xlink:href="urn:x-
nsgfc:FC:id:GSIP:1.8:BuiltUpArea">derivedFrom</relation>
      <relation xlink:href="urn:x-
nsgfc:AS:id:GSIP:1.8">partOf</relation>
      <relation xlink:href="urn:x-
nsgfc:VIEW:id:GSIP:1.8:Settlements">inView</relation>
      <relation xlink:href="urn:x-
nsgfc:VIEW:id:GSIP:1.8:SomeOtherView">inView</relation>
      <relation xlink:href="urn:x-
nsgfc:VIEW:id:GSIP:1.8:YetAnotherView">inView</relation>
      <relation xlink:href="http://www.interactive-
instruments.de/ows/repository/xmi/gsip.xml#element(//Foundation.Core.Cla
ss[Foundation.Core.ModelElement.name='BuiltUpArea'])">resource</relation
>
    </relations>
  </Resource>
```

9.4 Resource "Property Type"

9.4.1 Overview

Every attribute type or association role type in a UML application schema is described by one DDMS metadata resource.

In most cases, schema metadata that cannot be derived from the model itself will be represented in the UML model using the tagged value extension mechanism of UML. In this case, the tagged values are associated with the UML attribute or UML association end that represents the property type.

9.4.2 Subject

9.4.2.1 CS-W property

Subject (Core queryable property)

9.4.2.2 DDMS primary category

Subject (Mandatory)

9.4.2.3 Representation in the UML application schema

Two tagged values are used to represent this information:

- Tagged value "PrimaryCode": The content shall be the value of the alpha code.
- Tagged value "SecondaryCode": The content shall be the value of the DFDD code.

9.4.2.4 Representation in DDMS (schema metadata)

For the tagged values ddms:keyword elements with attributes ddms:value shall be created, the value of the tagged value shall be the value of the attribute.

9.4.3 Title

9.4.3.1 CS-W property

Title (Core queryable property)

9.4.3.2 DDMS primary category

Title (Mandatory)

9.4.3.3 Representation in the UML application schema

Tagged value "Title". The value shall be the name of the property type.

9.4.3.4 Representation in DDMS (schema metadata)

Value of tagged value "Title" (ddms:title).

9.4.4 Abstract

9.4.4.1 CS-W property

Abstract (Core queryable property)

9.4.4.2 DDMS primary category

Description (Optional)

9.4.4.3 Representation in the UML application schema

Tagged value "documentation" (pre-defined in the UML specification): Concatenation of

- the name of the property type
- ": "
- the definition of the property type
- " [desc] " (only if the description exists)
- the description of the property type (only if the description exists)

9.4.4.4 Representation in DDMS (schema metadata)

Value of tagged value "documentation" (in element ddms:description), but

- the name and ": " at the beginning are removed
- "[desc]" is replaced by "Additional description:"

9.4.5 Any Text

Not used

9.4.6 Format

9.4.6.1 CS-W property

Format (Core queryable property)

9.4.6.2 DDMS primary category

Format (Optional)

9.4.6.3 Representation in the UML application schema

Not applicable.

9.4.6.4 Representation in DDMS (schema metadata)

ddms:mimeType values are one of

- 'text/xml; subtype="xmi/1.0"': This value is used for a UML model that does not follow the stricter rules specified by ISO 19109 and/or ISO 19136

- 'text/xml; subtype="xmi/1.0/iso19109"': This value is used for a UML application schema that follows the rules specified by ISO 19109, but not the stricter rules specified by ISO 19136 Annex E
- 'text/xml; subtype="xmi/1.0/iso19136"': This value is used for a UML application schema that does follow the rules specified by ISO 19136 Annex E

In OWS-4 all application schemas will be schemas of mime type 'text/xml; subtype="xmi/1.0/iso19136"' or 'text/xml; subtype="xmi/1.0/iso19109"'.

For GML, the code list of known values is:

- text/xml; subtype="gmlas/2.1"
- text/xml; subtype="gmlas/3.1"
- text/xml; subtype="gmlas/3.1/sfgml"
- text/xml; subtype="gmlas/3.2"

ddms:medium is always "digital".

9.4.7 Identifier

9.4.7.1 CS-W property

Identifier (Core queryable property)

9.4.7.2 DDMS primary category

Identifier (Mandatory)

9.4.7.3 Representation in the UML application schema

Tagged value "Identifier". It is strongly recommended to use a URN (see IETF RFC 2141).

9.4.7.4 Representation in DDMS (schema metadata)

Value of tagged value "Identifier" (ddms:identifier with ddms:qualifier="URN").

9.4.8 Modified

9.4.8.1 CS-W property

Modified (Core queryable property)

9.4.8.2 DDMS primary category

Date (Optional)

9.4.8.3 Representation in the UML application schema

Tagged value "Modified": If provided, the content shall be specified as "YYYY-MM-DD".

9.4.8.4 Representation in DDMS (schema metadata)

Value of tagged value "Modified" (attribute ddms:created of ddms:dates), if the tagged value is provided.

9.4.9 Type

9.4.9.1 CS-W property

Type (Core queryable property)

9.4.9.2 DDMS primary category

Type (Optional)

9.4.9.3 Representation in the UML application schema

Not applicable

9.4.9.4 Representation in DDMS (schema metadata)

Attribute ddms:value of ddms:type is always "PropertyType".

9.4.10 Bounding Box

Not used.

Note: The relevant DDMS primary categories are Geospatial Coverage and Temporal Coverage.

9.4.11 CRS

Not used.

9.4.12 Association

9.4.12.1 CS-W property

Association (Core queryable property)

The following associations are used:

- derivedFrom: *UML Property type* is derived from *Feature Catalog Property type*
- partOf: *UML Property type* is part of *UML Feature type*

9.4.12.2 DDMS primary category

Not described by DDMS, extension required.

9.4.12.3 Representation in the UML application schema

The following associations are used:

- derivedFrom: (not represented)
- partOf: Containment of a property type attribute or association end in a feature type class

9.4.12.4 Representation in DDMS (schema metadata)

relations/relation elements (preliminary namespace "http://www.opengis.net/ows4/schemametadata") with values "derivedFrom" or "partOf".

attribute xlink:href of relation element is

- derivedFrom: a URI representing the property type in the feature catalogue, it is recommended to use a URN
- partOf: the tagged value "Identifier" of the feature type class owning the attribute/association end

9.4.13 Security

9.4.13.1 CS-W property

Security (Additional queryable property)

9.4.13.2 DDMS primary category

Security (Mandatory)

9.4.13.3 Representation in the UML application schema

See 'Security' for Application Schema resources. Typically no tagged value will be provided for property types. In this case, the value for the application schema applies also to the property type.

9.4.13.4 Representation in DDMS (schema metadata)

As for Application Schema resources.

9.4.14 Creator

9.4.14.1 CS-W property

Creator (Additional queryable property)

9.4.14.2 DDMS primary category

Creator (Mandatory)

9.4.14.3 Representation in the UML application schema

See 'Creator' for Application Schema resources. Typically no tagged value will be provided for property types. In this case, the value for the application schema applies also to the property type.

9.4.14.4 Representation in DDMS (schema metadata)

As for Application Schema resources.

9.4.15 Other DDMS elements with fixed values

An element ddms:language with attribute ddms:qualifier and value "ISO 639-1" and attribute ddms:value with value "en" is part of the DDMS resource element.

An element ddms:rights with attribute ddms:copyright and value "true" is part of the DDMS resource element.

9.4.16 DDMS XML example

```
  <Resource xmlns="http://metadata.dod.mil/mdr/ns/DDMS/1.3/">
    <identifier ddms:qualifier="URN" ddms:value="urn:x-
nsgfc:AS:id:GSIP:1.8:basicEncyclopediaNumber"/>
    <title ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">Basic Encyclopedia (BE) Number</title>
    <description ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">The unique
identifier of a feature as assigned in the Basic Encyclopedia (a
compilation of identified installations and physical
areas of potential significance as objectives for attack). [desc] It is
intended to be used to locate information about
the feature that is stored in other databases.</description>
    <language ddms:qualifier="ISO 639-1" ddms:value="en"/>
    <dates ddms:created="2006-08-05"/>
    <rights ddms:copyright="true"/>
    <type ddms:value="PropertyType"/>
    <creator ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">
      <Organization>
        <name>NGA</name>
        <phone>+1-703-814-4580</phone>
        <email>NCGIS-mail@nga.mil</email>
      </Organization>
```

```
    </creator>
    <format>
      <Media>
        <mimeType>text/xml; subtype="xmi/1.0/iso19109"</mimeType>
        <extent/>
        <medium>digital</medium>
      </Media>
    </format>
    <subjectCoverage>
      <Subject>
        <keyword ddms:value="BEN(???)"/>
        <keyword ddms:value="basicEncyclopediaNumber"/>
      </Subject>
    </subjectCoverage>
    <security ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency"/>
    <relations xmlns="http://www.opengis.net/ows4/schemametadata">
      <relation xlink:href="urn:x-
nsgfc:FC:id:GSIP:1.8:BuiltUpArea:basicEncyclopediaNumber">derivedFrom</r
elation>
      <relation xlink:href="urn:x-
nsgfc:AS:id:GSIP:1.8:BuiltUpArea">partOf</relation>
    </relations>
  </Resource>
```

9.5 Resource "View"

9.5.1 Overview

Every "View" described in GSIP is described by one DDMS metadata resource.

9.5.2 Subject

9.5.2.1 CS-W property

Subject (Core queryable property)

9.5.2.2 DDMS primary category

Subject (Mandatory)

9.5.2.3 Representation in DDMS (schema metadata)

One or more ddms:keyword elements with attributes ddms:value shall be created. The value of every ddms:value attribute shall be a keyword describing the subject of the view.

9.5.3 Title

9.5.3.1 CS-W property

Title (Core queryable property)

9.5.3.2 DDMS primary category

Title (Mandatory)

9.5.3.3 Representation in DDMS (schema metadata)

A ddms:title element with the name of the view.

9.5.4 Abstract

9.5.4.1 CS-W property

Abstract (Core queryable property)

9.5.4.2 DDMS primary category

Description (Optional)

9.5.4.3 Representation in DDMS (schema metadata)

A ddms:description element with a textual description of the view.

9.5.5 Any Text

Not used

9.5.6 Format

9.5.6.1 CS-W property

Format (Core queryable property)

9.5.6.2 DDMS primary category

Format (Optional)

9.5.6.3 Representation in DDMS (schema metadata)

A ddms:mimeType element with value 'text/xml'.

A ddms:medium element with the value "digital".

9.5.7 Identifier

9.5.7.1 CS-W property

Identifier (Core queryable property)

9.5.7.2 DDMS primary category

Identifier (Mandatory)

9.5.7.3 Representation in DDMS (schema metadata)

An element ddms:identifier with ddms:qualifier="URN" and a value that is a URN.

9.5.8 Modified

Not used.

9.5.9 Type

9.5.9.1 CS-W property

Type (Core queryable property)

9.5.9.2 DDMS primary category

Type (Optional)

9.5.9.3 Representation in DDMS (schema metadata)

Attribute ddms:value of ddms:type is always "View".

9.5.10 Bounding Box

Not used.

Note: The relevant DDMS primary categories are Geospatial Coverage and Temporal Coverage.

9.5.11 CRS

Not used.

9.5.12 Association

Not used.

9.5.13 Security

9.5.13.1 CS-W property

Security (Additional queryable property)

9.5.13.2 DDMS primary category

Security (Mandatory)

9.5.13.3 Representation in the UML application schema

Tagged values:

- IC:classification
- IC:ownerProducer
- IC:SCIcontrols
- IC:SARIdentifier
- IC:disseminationControls
- IC:FGIsourceOpen
- IC:FGIsourceProtected
- IC:releasableTo
- IC:nonICmarkings
- IC:classifiedBy
- IC:classificationReason
- IC:derivedFrom
- IC:declassDate
- IC:declassEvent
- IC:declassException
- IC:typeOfExemptedSource
- IC:dateOfExemptedSource
- IC:declassManualReview

9.5.13.4 Representation in DDMS (schema metadata)

The taged values are used to populate XML attribute instances of the following XML Schema definitions from the Intelligence Community Information Security Marking (IC ISM) Version 2.0 as the authoritative implementation of CAPCO:

- urn:us:gov:ic:ism:v2:SecurityAttributesOptionGroup

The values therefore shall conform to the rules of this specification.

The value of "IC:classification" shall be stored in the Catalogue Service as a classification. The allowed values for this classification by IC ISM are:

- U
- C
- S
- TS
- R
- CTS
- CTS-B
- CTS-BALK
- NU
- NR
- NC
- NS
- NS-S
- NS-A
- CTSA
- NSAT
- NCA

9.5.14 Creator

9.5.14.1 CS-W property

Creator (Additional queryable property)

9.5.14.2 DDMS primary category

Creator (Mandatory)

9.5.14.3 Representation in the UML application schema

Tagged Values "CreatorName" (name of the organisation), "CreatorPhone" (phone number of the organisation) and "CreatorEmail" (email address of the organisation).

9.5.14.4 Representation in DDMS (schema metadata)

According to the values of the tagged values (child elements ddms:name, ddms:phone and ddms:email of ddms:creator/ddms:Organization).

9.5.15 Publisher

9.5.15.1 CS-W property

Publisher (Additional queryable property)

9.5.15.2 DDMS primary category

Publisher (Optional)

9.5.15.3 Representation in the UML application schema

Tagged Values "PublisherName" (name of the organisation), "PublisherPhone" (phone number of the organisation) and "PublisherEmail" (email address of the organisation).

These will be fixed values for all NGA application schemas.

9.5.15.4 Representation in DDMS (schema metadata)

According to the values of the tagged values (child elements ddms:name, ddms:phone and ddms:email of ddms:publisher/ddms:Organization).

9.5.16 Other DDMS elements with fixed values

An element ddms:language with attribute ddms:qualifier and value "ISO 639-1" and attribute ddms:value with value "en" is part of the DDMS resource element.

An element ddms:rights with attribute ddms:copyright and value "true" is part of the DDMS resource element.

9.5.17 DDMS XML example

```
  <Resource xmlns="http://metadata.dod.mil/mdr/ns/DDMS/1.3/">
    <identifier ddms:qualifier="URN" ddms:value="urn:x-
nsgfc:VIEW:id:GSIP:1.8:Settlements"/>
    <title ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">Settlements</title>
    <description ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">...
description of the view...</description>
    <language ddms:qualifier="ISO 639-1" ddms:value="en"/>
    <rights ddms:copyright="true"/>
    <type ddms:value="View"/>
    <creator ICISM:classification="U" ICISM:ownerProducer="U.S. National
Geospatial-Intelligence Agency">
      <Organization>
        <name>NGA</name>
```

```
        <phone>+1-703-814-4580</phone>
        <email>NCGIS-mail@nga.mil</email>
      </Organization>
    </creator>
    <publisher ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency">
      <Organization>
        <name>NGA</name>
        <phone>+1-703-814-4580</phone>
        <email>NCGIS-mail@nga.mil</email>
      </Organization>
    </publisher>
    <format>
      <Media>
        <mimeType>text/xml</mimeType>
        <extent/>
        <medium>digital</medium>
      </Media>
    </format>
    <subjectCoverage>
      <Subject>
        <keyword ddms:value="Settlements"/>
        <keyword ddms:value="Buildings"/>
        <keyword ddms:value="Cities"/>
      </Subject>
    </subjectCoverage>
    <security ICISM:classification="U" ICISM:ownerProducer="U.S.
National Geospatial-Intelligence Agency"/>
  </Resource>
  <Resource xmlns="http://metadata.dod.mil/mdr/ns/DDMS/1.3/">
    <identifier ddms:qualifier="URN" ddms:value="urn:x-
nsgfc:VIEW:id:GSIP:1.8:ABC"/>
    ...
  </Resource>
```

9.5.18 Use of View resources in WFS clients

The intended process is as follows:

- A WFS client asks/searches the catalog for available views (which are similar to "layers"), eg by using keywords
- The user selects a view from the return list
- The WFS client retrieves the feature types that are associated with that view
- The WFS client constructs GetFeature request with all the feature types in the view
- The WFS client retrieves the features in the view from the WFS

One issue that was not addressed as part of OWS-4 is the workflow of linking the WFS service instances to the views so that the WFS client can easily identify all WFSs which are serving the data.