DGIWG – 116-2

Elevation Surface Model (ESM) GML Application Schema

Document type:	Standard
Document date:	1 August 2016
Edition:	1.0.1
Responsible Party:	DGIWG
Audience:	This document is approved for public release and is available on the DGIWG website, http://www.dgiwg.org/dgiwg/
Abstract:	This document defines the ESM GML application schema and documents the process used to derive this application schema from the ESM UML model, associated to STD-116-1
Copyright:	

Table of Contents

1. Scope ... 1
2. Conformance ... 1
2.1. GML (ISO 19136) conformance ... 1
2.2. GMLCOV conformance ... 2
2.3. GML 0d geometry conformance ... 2
2.4. ESM GML schema conformance ... 2
3. Normative References ... 3
4. Terms and definitions, and abbreviated terms ... 4
4.1. Terms and definitions ... 4
4.2. Abbreviated terms ... 4
5. Applicability and use ... 4
6. ESM UML implementation model (informative) ... 5
6.1. Introduction ... 5
6.2. ESM UML implementation model ... 5
7. ESM GML application schemas (normative) ... 6
7.1. Introduction ... 6
7.2. ESM GML Application schemas ... 6
7.3. ESM Coverage requirements ... 6
7.4. ESM PointSet requirements ... 7
8. GML data realizations of DGIWG GML profiles ... 8
8.1. General ... 8
8.2. ESM Coverage data ... 8
8.3. ESM PointSet data ... 8
8.4. ESM metadata ... 9
Annex A : ESM GML Application Schema Abstract Test Suites ... 10
A.1 Introduction ... 10
A.2 Abstract test suites for ESM-based elevation schemas ... 10
Annex B Abstract test suites for ESM GML data ... 12
B.1 Introduction ... 12
B.2 General tests for ESM GML instance ... 12
B.3 Tests for the ESM Coverage GML instance ... 12

B.4 Tests for the ESM PointSet GML instance 12
B.5 ESM metadata set 12
Annex C : ESM Application Schema Use cases 14
Annex D : ESM UML Implementation Model 16
Annex E : ESM Application Schemas 19
Annex F : Introduction to the Geography Markup Language (GML) 20
Annex G : GML realization of the ESM UML Profiles: methodology 22
G.1 Procedure for generating the DGIWG GML application schemas for the DGIWG ESM UML Profiles 22
G.2 Generating the different GML application schemas 23
G.3 Adapting the generated profiles according to the specializations defined by this document 23

List of Figures

Figure D.1 – ESM Coverage package, including GridCoverage, PointCoverage, CoverageCollection 16
Figure D.2 – ESM PointSet package, including PointSet and PointSetCollection 17
Figure D.3 – ESM metadata package, and relationship with ESM Coverage, PointSet and ESM collections 18
Figure F.1 – Relationship between GML standard, application schema and data instance 20
Figure F.2 – Relationship between GML standard, profile and application schema 21

i. Submitting organizations

France, Sweden, Czech Republic, United Kingdom, USA associated in DGIWG D32

ii. Revision history

Date	Release	Primary clauses modified	Description
26/08/2013	0.1	All	Initial version submitted for nation review and comment.
22/04/2014	0.2		Resolution of comments of fall 2013 DGIWG Technical Panel + structuring into 2 distinct schemas, 1 coverage-based (GMLCOV), other one based on DGIWG GML L1_3D profile (of DGIWG STD-113)
29/05/2014	0.3		Final draft after DGIWG TP Prague meetings
26/06/2014	1.0 (draft r1)		Final draft after project team (D32) telecon (June 2014)
2/10/2014	1.0		Standard for publication (after resolution of comments)
1/08/2016	1.0.1		Correction on Requirement 10 in 8.2: support of vertical coordinate reference system by rangeType instead of rangeSet. Update of DMF reference (1.0.1) and subsequent addition of ISO 19115-1 as normative reference.

iii. Future work

Incorporation of the TIN model into the application schema once it is defined as a coverage in GML and GMLCOV (OGC).

Introduction

The Elevation Surface Model Standardized Profile (DGIWG STD-116-1) provides the conceptual schema for describing and manipulating the information content required for the exchange of surface elevation information for a variety of surfaces such as bare earth, vegetation canopy, or bathymetric depth, under different data models, such as coverages (Rectified Grids, Point Coverages or TIN Coverages) or Point Sets, together with the associated metadata.

ESM does not address elevation contour lines or other elevation data views that are typically derived from coverage data and provided as discrete features. Contour lines are discrete 2D features that have a single elevation value across their spatial domain. Coverage features (grid, TIN, point) have multiple elevation values in their attribution, with every direct position within the 2D geometry of the coverage having a single value. Features in an elevation point set (included in ESM) are 3D in their geometry, and therefore no elevation value attribution is necessary.

This document defines the ESM GML application schema that is required for the documentation and GML encoding of this ESM content. It contains the relevant conformance clauses and conformance classes associated to the various use cases. It also documents the process used to derive these ESM application schemas from the ESM UML model, associated to STD-116-1, on the basis of the OGC GML Coverage Application Schema (GMLCOV) , developed to support the OGC Web Coverage Service (WCS2.0) for the Coverage model, or on the basis of the DGIWG GML L1_3D profile (of DGIWG STD-113) for the Point Set model . The aim of this ESM GML application schema is to comply either with GMLCOV (for the ESM Coverage components), in order to facilitate ESM data access via a WCS service for Coverage data, or with GML3.2 in order to facilitate ESM data access via a WFS service for Point Set data.

Limitation: As the GML coverage application schema, in its present version, does not handle the TIN coverage model, the TIN Coverage component is currently excluded from this ESM application schema.

NB: Another more technical justification of this choice of a GMLCOV-based application schema is to avoid the creation of other Coverage applications schemas, and to reuse this OGC Coverage Application schema that should be implemented presently and in the future for the sake of interoperability with Coverage data.

1. Scope

This document defines the Elevation Surface Model (ESM) GML application schemas that are required for the documentation and GML encoding of this ESM content, and associated conformance classes. It also documents the process used to derive these ESM application schemas from the ESM UML model provided by the ESM standard (DGIWGSTD-116-1).

As stated in STD-116-1, the ESM includes a grid and a point coverage models, as well as a TIN coverage model (not retained in the present version of this application schema), and a point set model (when point geometry does not meet the definition of a coverage).

2. Conformance

Conformance to ESM GML Application schema may apply to:

- A Candidate Profile of the ESM GML Application Schema, i.e. an ESM Application Schema Specification using a subset of the ESM GML Application Schemas and possibly extending these schemas.
- A candidate ESM GML instance, i.e. a GML instance describing an ESM resource, including its ESM metadata.

Any ESM profile GML Application schema requires conformance to:

- the specific ESM conformance classes, for each relevant ESM profile among the ESM schema conformance classes identified below, including the ESM metadata conformance, based on DMF conformance classes;
- the relevant GML (ISO 19136) conformance classes, as stated in 2.1;
- the relevant GMLCOV conformance classes, for the Coverage artifacts, as stated in 2.2;
- the relevant GML 0-dimensional geometry for the Point Set artifacts, whose geometry is ruled by DGIWG GML L1.3D.0d profile conformance classes, as stated in 2.3.

Any ESM GML data instance claiming conformance to the DGIWG ESM GML Profiles shall pass the applicable test specified in Annex B - : Abstract test suites for ESM GML data.

Any software implementation claiming conformance to the DGIWG ESM GML Application Schemas defined in this document shall reference the ESM schema and compliance level class supported by the implementation. The implementation shall also document its ability to import and/or export ESM GML instances.

2.1. GML (ISO 19136) conformance

An ESM GML Application schema requires conformance to the relevant GML3.2 (ISO 19136) conformance classes:

- GML application schemas
- GML application schemas converted from an ISO 19109 Application Schema in UML
- GML application schemas defining Features and Feature Collections
- GML application schemas defining Spatial Geometries

- GML application schemas defining Time
- GML application schemas defining Coordinate Reference Systems
- GML application schemas defining Values.

NB: The Coverages component of GML application schemas is superseded by OGC GMLCOV application schema (see following clause) which

Most of the schema components specified in ISO 19136 implement concepts defined in the ISO 19100 series of International Standards. In these cases, the conformance classes defined in ISO 19136 are based on the conformance classes defined in the corresponding standard. Mandatory requirements of ISO 19136 remain mandatory.

2.2. GMLCOV conformance

For the Coverage artifacts, an ESM Application schema requires conformance to OGC GMLCOV (as stated in OGC 09-146r2, section 2):

- the abstract conformance class gml-coverage, subsetted to multi-point coverage and rectified grid coverage for the Coverage elements;
- at least one of the concrete GMLCOV conformance classes: gml, multipart, and special-format (for at least one format such as GeoTIFF, GMLJP2, BIIF).

2.3. GML 0d geometry conformance

For the Point Set artifacts, an ESM Application schema requires conformance to GML 0d geometry on the basis of the DGIWG GML conformance class L1.3D.0d of profile L1_3D (as specified in DGIWG STD-113, annex A.6) for the geometry (supported by the pointSet attribute).

2.4. ESM GML schema conformance

The DGIWG ESM GML profile provides geometric classes, as a subset of GML and GMLCOV, to limit the complexity of the ESM schemas. When profiling an ESM application schema, a user can choose an ESM GML schema conformance class, corresponding to a specific need (see Annex C), as stated below.

Consequently 2 compliance levels for ESM GML application schema and ESM GML data have been defined:

- ESM_COV: single Coverage (based on RectifiedGridCoverage of GMLCOV) or collection of Coverages
- ESM_PTS: single Point Set (based on DGIWG GML conformance class L1.3D.0d of profile L1_3D for its geometry) or collection of Point Sets)

For each of this compliance level, abstract tests are described (Annex A : ESM GML Application Schema Abstract Test Suites and Annex B : Abstract test suites for ESM GML data).

3. Normative References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of these profiles.

International Standards

ISO 639-2:1998 Codes for the representation of names and languages

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

ISO 19107:2003 Geographic information – Spatial schema

ISO 19108:2002/Cor 1:2006 Geographic information – Temporal schema

ISO 19109:2003 Geographic information – Rules for application schema

ISO 19111:2007 Geographic information – Spatial referencing by coordinates

ISO 19115:2003 Geographic information – Metadata

ISO 19115-1:2014 Geographic information – Metadata - Part 1: Fundamentals[1]

ISO 19115/Cor.1:2006 Geographic information – Metadata – Technical Corrigendum 1

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

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

ISO 19136:2007 — Geographic information – Geography Markup Language (GML)

ISO 19138:2006 Geographic information – Data quality measures

ISO 19139:2006 Geographic information – Metadata – XML schema implementation

OGC® GML Application Schema – Coverages, Version: 1.0.1, 11 May 2012 (OGC 09-146r2)

DGIWG STD–116-1: Elevation Surface Model, Edition 1.0.1, 10 June 2014

DGIWG STD-114: DGIWG Metadata Foundation, Edition 1.0.1, 21 November 2014

DGIWG STD–113: DGIWG Profiles of ISO 19107 and GML realization, Edition 1.0, 16 Dec. 2010

[1] Revision of ISO 19115:2003

4. Terms and definitions, and abbreviated terms

4.1. Terms and definitions

NOTE The terms and definitions of the base standards ISO 19106:2004, ISO 19107:2003, ISO 19123:2005 and ISO 19136:2007, as well as DGIWG STD–116-1 (ESM) apply to this profile. Some abbreviated terms are repeated in this document, for the sake of readability.

4.2. Abbreviated terms

DMF	DGIWG Metadata Foundation
ESM	Elevation Surface Model
GML	Geography Markup Language
ISO	International Organisation for Standardization
OCL	Object Constraint Language
OGC	Open Geospatial Consortium
UML	Unified Modelling Language
XML	eXtensible Markup Language

5. Applicability and use

This ESM standardized application schema is applicable to:

- any GML encoding of an ESM data content, claiming compliance to ESM application schema
- the development of a GML application schema for any ESM-compliant product.

It is used to provide the GML/XML instance (based on a GMLCOV extension for ESM coverage artifacts) that should be associated to any ESM data (in any available “legacy” format – such as GeoTIFF, JPEG2000 or BIIF) in order to provide the coverage instance associated to ESM data, thus providing a web coverage service enablement of the ESM data.

This GML/XML instance may include or reference an ESM metadata resource, which provide a XML instance (based on DMF schema).

This ESM Application Schema is intended to result in a higher degree of interoperability between elevation (including bathymetric) data user domains based on GML and GML Coverage application schemas, the DGIWG Metadata Foundation (DMF), and other DGIWG imagery or topographic data standards.

6. ESM UML implementation model (informative)

6.1. Introduction

The DGIWG ESM UML model associated to ESM standard (STD–116-1) includes the following components:

- Coverage model: Rectified Gridded or Point Coverages, and ESM CoverageCollection
- Point Set model: GM_MultiPoint and ESM PointSetCoverageCollection
- ESM metadata model: MD_Metadata describing DS_DataSet (for ESM Coverage or PointSet) or DS_Aggregate (for CoverageCollection or PointSetCollection), with the constraint of using DMF-all schema.

This ESM abstract model is based on the ISO 19123 for its Coverage components, and ISO TC211 metadata standards for its associated ESM metadata component.

From this abstract UML model, based on ISO TC211 standards, an implementation model (for GML) has been developed, based on the following standards or profiles:

- OGC GMLCOV, for the RectifiedGridCoverage and MultiPointcoverage, in replacement of ISO 19123,
- GML3.2, with the restriction to use only 3D geometric primitives as defined in sub-profile L1.3D.0d of profile L1_3D of DGIWG-STD-113 for the PointSetModel,
- GML Feature Collection.

NB: In order to avoid unnecessary verbose element names, as the schemas should be provided under DGIWG domain and ESM namespace, the prefix ‘ESM_’ for the ESM classes (in ESM specification) has been suppressed in the UML implementation model.

6.2. ESM UML implementation model

The ESM UML implementation model includes all specified components of ESM model, organized according to 2 packages, as follows:

- ESM Coverage: this package includes GridCoverage and PointCoverage, based on a simple ESM extension of GMLCOV, restricted to RectifiedGridCoverage and MultiPointCoverage components of GMLCOV, and CoverageCollection.
- ESM PointSet: this package includes PointSet, that must use geometric primitives as defined in sub-profile L1.3D.0d of profile L1_3D of DGIWG-GML profiles (STD-113) for its geometry, and PointSetCollection.

Each ESM feature (Coverage or PointSet) or feature collection is associated with an ESM metadata set based on DGIWG metadata foundation, based on TC211 metadata standards.

The use of UML in the ESM UML implementation model is based on ISO 19103 – Conceptual Schema Language.
OCL (part of UML) may be used to explicitly document constraints.
The resulting ESM UML implementation model is annexed to this document (file ESM_GMLCOV_GML.EAP). Annex D provides the 3 class diagrams for:

- ESM Coverage package: GridCoverage, PointCoverage and CoverageCollection,
- ESM PointSet package: PointSet and PointSetCollection,
- ESM metadata, associated to single ESM GridCoverage, PointCoverage or PointSet or to ESM collections CoverageCollection or PointSetCollection.

7. ESM GML application schemas (normative)

7.1. Introduction

This section describes the two ESM GML Application schemas derived from the two ESM UML packages model on the basis of GML and GML Coverage application schemas, as described in Annex G. It identifies and references the ESM GML application schemas standardized by this document.

7.2. ESM GML Application schemas

The ESM GML Application schemas correspond to the ESM UML implementation model packages specified in this document that may conform to the two corresponding ESM conformance classes.

The ESM GML Application schemas are normative and organized according to the following two schemas:

- ESMCoverage schema: for Rectified Grid coverage or Point coverage, and collection of such coverages,
- ESMPoint Set schema: for Point Set (based on sub-profile L1.3D.0d of profile L1_3D of DGIWG-GML profiles), and collection of PointSets.

The following rules have be adopted for namespace: ESM namespace under DGIWG domain.

7.3. ESM Coverage requirements

Requirement 1: An ESM coverage **shall** have the following attributes, inherited from the GMLCOV specification:

- one domainSet: spatio-temporal domain of the coverage
- one rangeType: structure definition of the coverage range values;
- one rangeSet: coverage range values, on the basis of an external file;
- zero or one metadata (restriction of GMLCOV): metadata may be included or referenced
- zero or one coverageFunction.

Requirement 2: An ESM coverage **shall** have a commonPointRule attribute, inherited from ESM specification, with the ESM restricted values of the CV_CommonPointRule (average (default), low or high).

7.3.1. ESM Grid Coverage requirements

Requirement 3: The following additional requirements shall apply to ESM Grid coverages:

- The domainSet shall be restricted to a gml:RectifiedGrid whose dimension is constrained to 2.
- The quantity element of the rangeType **shall** specify the list of no data values.

7.3.2. ESM Point Coverage requirements

Requirement 4: The following additional requirements shall apply to ESM Point coverages:

- The domainSet shall be restricted to a gml:MultiPoint whose dimension is constrained to 2.

7.3.3. ESM CoverageCollection

No specific requirement applies to ESM Coverage collection.

7.4. ESM PointSet requirements

Requirement 5: The following additional requirements shall apply to ESM PointSet:

- The dimension of the gml:MultiPoint geometry is constrained to 3.

No specific requirement applies to ESM PointSet collection.

8. GML data realizations of DGIWG GML profiles

8.1. General

This section contains information and requirements on ESM GML instance compliance against the two levels of conformance defined in section 2 that are ESM_COV and ESM_PTS and the two corresponding schema ESM_Coverage and ESM_PointSet.

Requirement 6: Resources referenced in GML instances **shall** be identified by URI following the OGC document 07-092r3 and maintained in http://www.opengis.net/def

8.2. ESM Coverage data

Requirement 7: An ESM Coverage instance **shall** be validated by ESMCoverage schema and conform to ESM_COV conformance class.

This applies to the ESM GridCoverage (RectifiedGrid geometry) or PointCoverage, or CoverageCollection of such coverages.

Requirement 8: The RectifiedGridCoverage model of GMLCOV requires the definition of the Horizontal CRS associated to each coverage (in the domainSet).

Requirement 9: The rangeType **shall** specify the unit of measure of the elevation coverage values (gmlcov:rangeType/swe:DataRecord/swe:uom).

Requirement 10: The rangeType **shall** reference one vertical coordinate reference system (by the *referenceFrame* attribute in the SWEDataRecord Quantity element)

Requirement 11: In case nil-values are identified, they **shall** be identified in the GMLCOV (gmlcov:rangeType/swe:DataRecord/swe:field/swe:Quantity/swe:nilValues) with an appropriate swe:nilValue/@reason to provide the reason.

Requirement 12: For ESM Grid coverages, the grid origin of the domainSet, which is located at grid coordinates (0, 0), **shall** be the upper left point of the elevation coverage.

Requirement 13: All the ESM coverage instances to which an aggregated CoverageCollection instance refers **shall** share the same Coordinate Reference Systems (Horizontal and Vertical).

8.3. ESM PointSet data

Requirement 14: An ESM PointSet instance **shall** be validated by ESM PointSet schema and conform to ESM_PTS conformance class.

This applies to PointSet (GML 0d geometry component with geometry based on profile L1.3D.0d) or PointSetCollection of such PointSets.

Requirement 15: All the ESM PointSet instances to which an aggregated PointSetCollection instance refers **shall** share the same Coordinate Reference Systems (Horizontal and Vertical).

8.4. ESM metadata

Depending on implementation scheme, ESM metadata may be associated (or included) to an ESM GML instance, or not.

Requirement 16: In case an ESM metadata is associated (or included) to an ESM GML instance **shall** be validated by DMF-all schema, and conform to:

- DMF/Data+ requirement class
- ESM metadata requirements (as specified in ESM Annexe A-2 Metadata test suite).

ESM metadata apply either to an ESM Dataset (Coverage or PointSet), or to an ESM Collection.

ESM metadata associated (or included) to an ESM GML dataset may contain redundant information with the ESM GML coverage instance.

Requirement 17: ESM metadata shall be consistent with the corresponding information specified by the ESM GML instance in gml:domainSet or gmlcov:rangeType. In case of discrepancies the gml:domainSet or gmlcov:rangeType information takes precedence.

Annex A: ESM GML Application Schema Abstract Test Suites

(normative)

A.1 Introduction

This Annex provides abstract test suites for the elevation profile application schemas that may be developed based on the ESM application schemas specified in this document.

A.2 Abstract test suites for ESM-based elevation schemas

A.2.1 Abstract test suite for ESM Coverage based schema

A.2.1.1 Schema imports ESM Coverage schema

a) Test Purpose: Verify that the ESM Coverage schema is imported in the schema and identified as annotation

b) Test Method: Inspect the implementation.

c) Reference: This document, clauses 7.2

d) Test Type: Capability Test

A.2.1.2 Abstract test for an ESM Coverage based schema as a valid GMLCOV Coverage

a) Test Purpose: Verify that the ESM Coverage based schema is a valid GMLCOV Coverage

b) Test Method: Inspect the implementation.

c) Reference: This document, clause 7.3, requirement 1

d) Test Type: Capability Test

A.2.1.3 Abstract test for an ESM Grid Coverage based schema as a valid ESM Grid Coverage profile

a) Test Purpose: Verify that the ESM Grid Coverage based schema is a valid ESM Grid Coverage

b) Test Method: Inspect the implementation.

c) Reference: This document, clause 7.3, requirements 2 and 3

d) Test Type: Capability Test

A.2.1.4 Abstract test for an ESM Point Coverage based schema as a valid ESM Point Coverage profile

a) Test Purpose: Verify that the ESM Point Coverage based schema is a valid ESM Point Coverage

b) Test Method: Inspect the implementation.

c) Reference: This document, clause 7.3, requirements 2 and 4

d) Test Type: Capability Test

A.2.2 Abstract test suite for ESM PointSet based schema

A.2.2.1 Schema imports ESM PointSet schema

a) Test Purpose: Verify that the ESM PointSet schema is imported in the schema and identified as annotation

b) Test Method: Inspect the implementation.

c) Reference: This document, clause 7.2,

d) Test Type: Capability Test

A.2.2.2 Abstract test for an ESM PointSet based schema as a valid ESM PointSet profile

a) Test Purpose: Verify that the ESM PointSet based schema is a valid ESM PointSet

b) Test Method: Inspect the implementation.

c) Reference: This document, clause 7.4, requirement 5

d) Test Type: Capability Test

Annex B: Abstract test suites for ESM GML data

(normative)

B.1 Introduction

This Annex provides abstract test suites for ESM GML instances build upon the DGIWG ESM GML application schemas.

B.2 General tests for ESM GML instance

a) Test Purpose: Verify that ESM GML instance satisfy requirements in section 8.1.(URI references to external resources)
b) Test Method: Inspect the application schema.
c) Reference: This document, clause 8.1, requirement 6
d) Test Type: Capability Test

B.3 Tests for the ESM Coverage GML instance

a) Test Purpose: Verify that ESM GML instance satisfy requirements in section 8.2 for RectifiedGridCoverage or MultiPointCoverage.
b) Test Method: Inspect the application schema.
c) Reference: This document, clause 8.2, requirements 7 to 13
d) Test Type: Capability Test

B.4 Tests for the ESM PointSet GML instance

(Conformance level L1_3D for 0d geometry of PointSet)

a) Test Purpose: Verify that GML instance satisfy requirement in section 8.3
b) Test Method: Inspect the application schema.
c) Reference: This document, clause 8.3, requirement 15
d) Test Type: Capability Test

B.5 ESM metadata set

B.5.1 Abstract test for ESM metadata set as valid DMF Metadata set implementation

a) Test Purpose: Verify that the ESM metadata set is a valid metadata set implementation of DMF (based on DMF/Core + Common + Data + Data+)
b) Test Method: Inspect the implementation.
c) Reference: This document, requirement 16 and DGIWG DMF: Annex A.4 Test module on candidate metadata set
d) Test Type: Capability Test

B.5.2 Abstract test for ESM metadata set as valid ESM metadata set implementation

a) Test Purpose: Verify that the ESM metadata is a valid ESM metadata set

b) Test Method: Inspect the implementation.

c) Reference: This document, requirement 16 and DGIWG ESM 1.0: Annex A.2 Metadata Test Suite and A.3 User-defined Extension Metadata Test Suite (if applicable) and A.4.1 Metadata Profiles Test Case (if applicable)

d) Test Type: Capability Test

B.5.3 Abstract test for ESM metadata set as consistent with ESM GML instance

a) Test Purpose: Verify that the ESM metadata is consistent with ESM GML instance

b) Test Method: Inspect the implementation.

c) Reference: This document, requirement 17

d) Test Type: Capability Test

Annex C: ESM Application Schema Use cases

(informative)

The following use cases offer an overview of possible implementations of ESM model with the corresponding Application Schema.

UC#	Use Case	Initiating Actor	Receiving Actor	Applicable ESM Conformance class[2]	Description
1	**Produce / encode ESM data and schema**	Geospatial Resource Custodian			
1.1	Produce simple ESM data based on Grid or Point Coverage model	Geospatial Resource Custodian, or Geospatial unit or Geospatial specialist	All	ESM_COV	ESM data associated to a Single ESM Grid or Point Coverage data
1.2	Produce simple ESM data based on TIN Coverage model	Geospatial Resource Custodian, or Geospatial unit or Geospatial specialist	All	ESM_TIN[3]	ESM data associated to a Single ESM TIN Coverage data
1.3	Produce simple ESM data based on Point Set model.	Geospatial Resource Custodian, or Geospatial unit or Geospatial specialist	All	ESM_PTS	ESM data associated to a Single ESM Point Set data. This model is based on the DGIWG GML Profile of 19107: profile L1_3D ("spaghetti") for 0d (points) primitives.
1.4	Produce collection of ESM data based on Grid or Point Coverage Model	Geospatial Resource Custodian, or Geospatial unit or Geospatial specialist	All	ESM_COV	Collection of ESM Grid or Point Coverage data
1.5	Produce collection of ESM data based on TIN Coverage Model	Geospatial Resource Custodian, or Geospatial unit or Geospatial specialist	All	ESM_TIN[3]	Collection of ESM TIN Coverage data

[2] See 2.4 to identify the corresponding ESM GML schema conformance clause.

[3] Not implemented in the current version.

UC#	Use Case	Initiating Actor	Receiving Actor	Applicable ESM Conformance class[2]	Description
1.6	Produce collection of ESM data based on Point set Model	Geospatial Resource Custodian, or Geospatial unit or Geospatial specialist	All	ESM_PTS	Collection of ESM Point Set data
2	**Visualize ESM metamodel information**	Any actor		ESM_COV + ESM_PTS	
3	**Download ESM data (and associated metamodel)**				
3.1	Download ESM data (and associated metamodel) for a simple / single ESM data (Coverage or Point Set)	Any actor	Client or Client software	ESM_COV + ESM_PTS	May use WCS2.0 for ESM.COV compliant data. May use WFS2.0 for ESM.PTS compliant data.
3.1	Download ESM data (and associated metamodel) for a collection of ESM data (Coverage or Point Set)	Any actor	Client or Client software	ESM_COV + ESM_PTS	May use WFS2.0 for collections of ESM.PTS compliant data. (WCS2.0 cannot be used, as WCS2.0 is only able to request 1 single coverage)
4	**Processing and Analysis of ESM Data**	Geospatial Unit	Geospatial Unit or Geospatial Specialist	ESM_COV + ESM_PTS	May use WPS or WCPS for Coverage compliant data

Annex D: ESM UML Implementation Model
(informative)

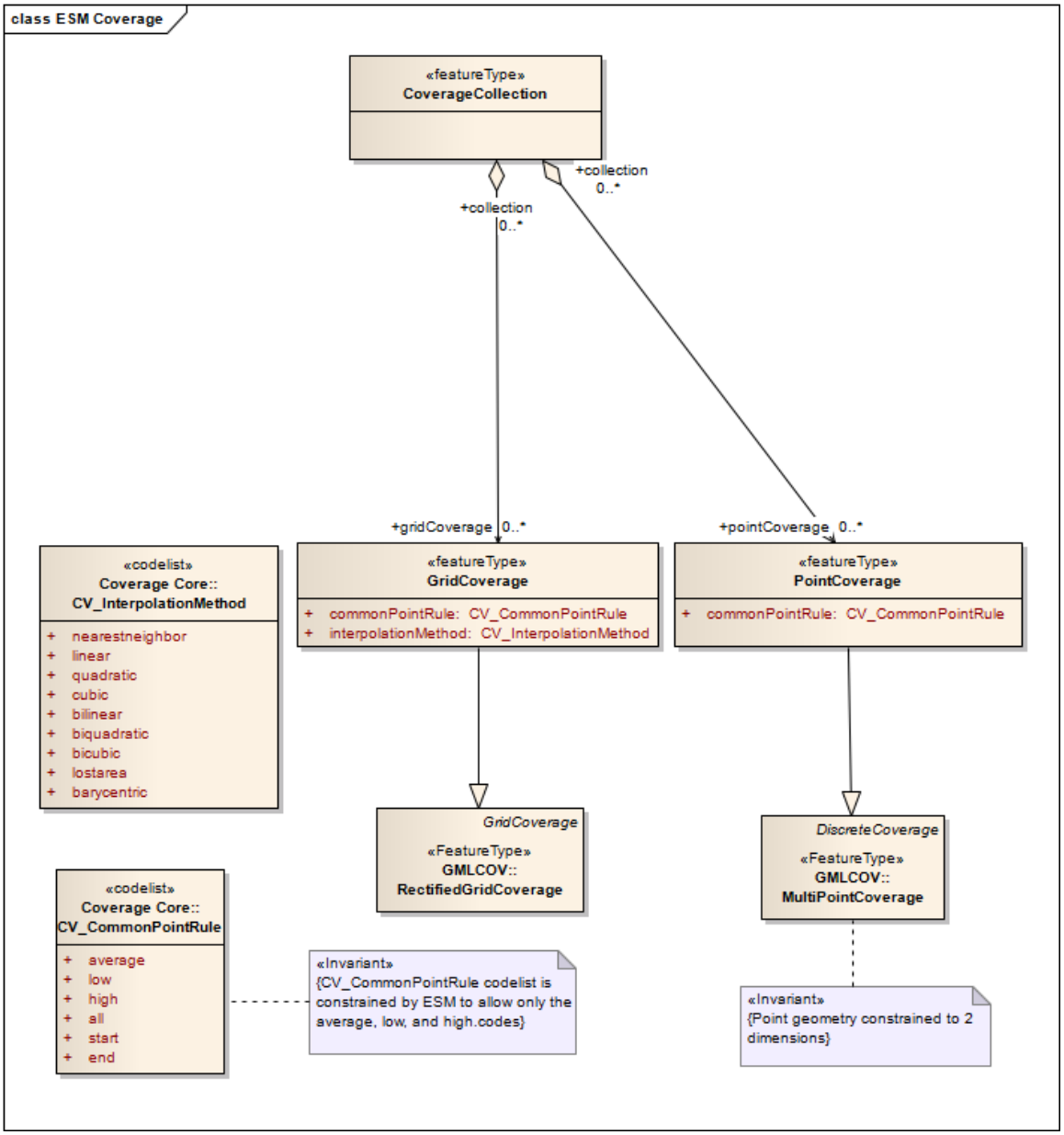

Figure D.1 – ESM Coverage package, including GridCoverage, PointCoverage, CoverageCollection

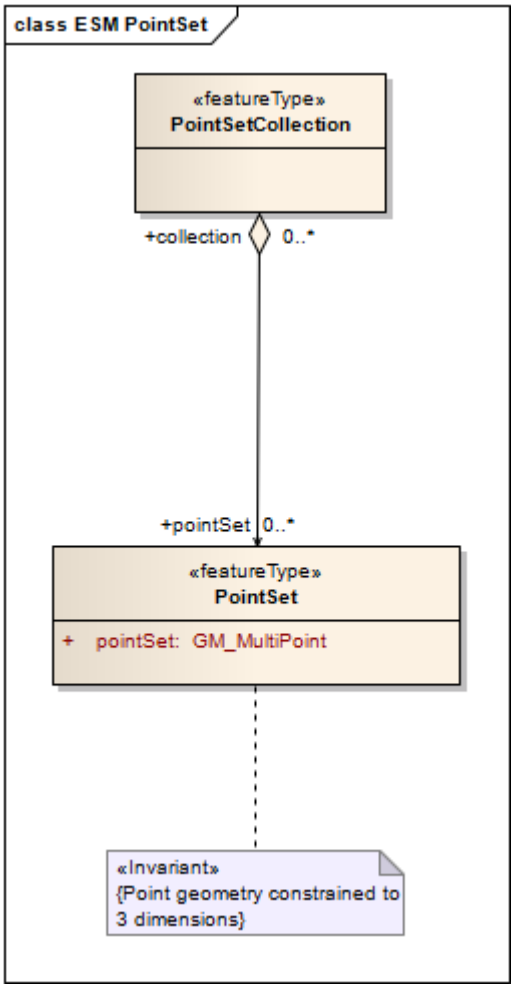

Figure D.2 – ESM PointSet package, including PointSet and PointSetCollection

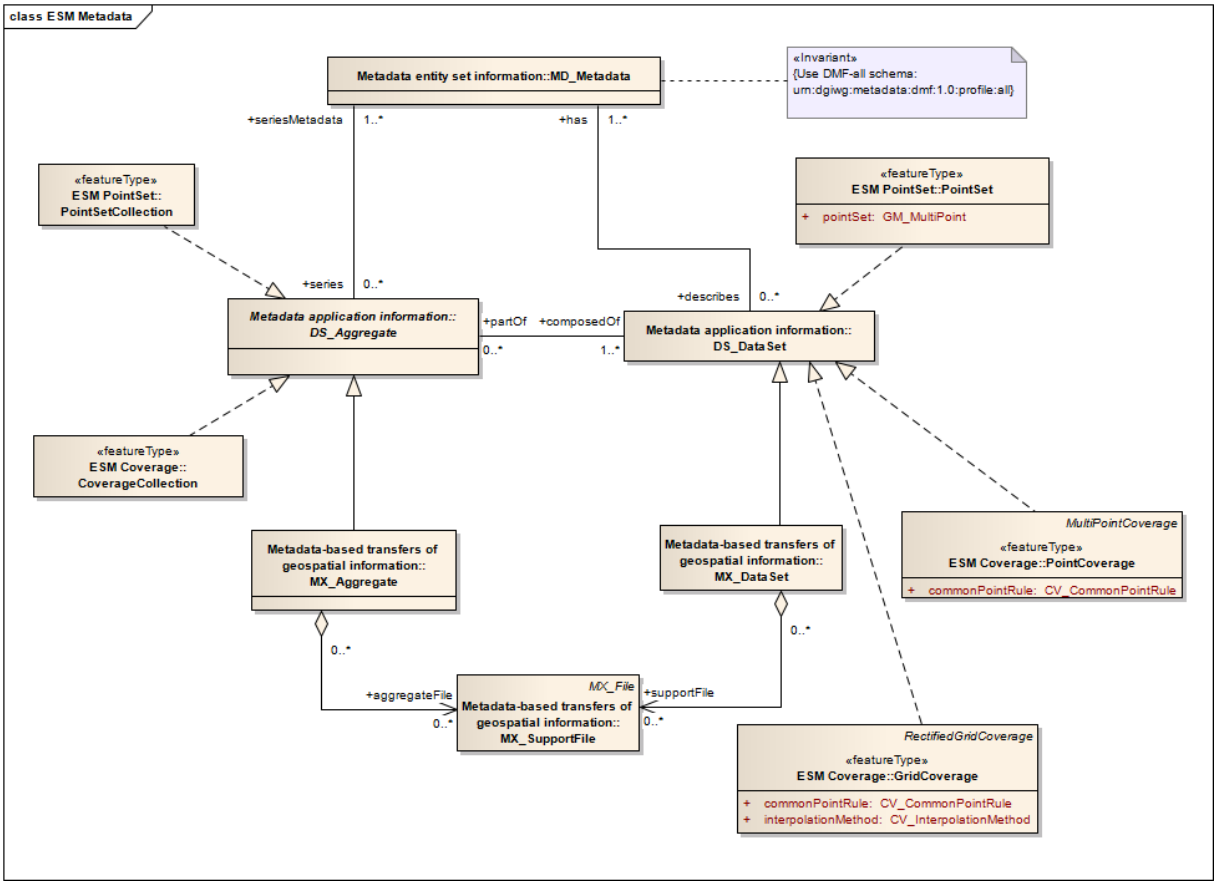

Figure D.3 – ESM metadata package, and relationship with ESM Coverage, PointSet and ESM collections

Annex E: ESM Application Schemas

(normative)

ESM GML Application schema is composed of:

- ESM Coverage schema for Rectified Grid coverage or Collection of Rectified Grid coverages
- ESM PointSet schema for PointSet (based on sub-profile L1.3D.0d of profile L1_3D of DGIWG-GML profiles) or Collection of Point Sets.

Note: The schemas are provided in a zipped file associated to this document. In the future, they should be provided in as DGIWG schema resources.

Annex F: Introduction to the Geography Markup Language (GML) (informative)

Note: This annex is copied from DGIWG STD-113.

GML enables an interoperable transfer of geo-data between distributed systems. It offers an open, vendor-neutral framework for the definition of application schemas that describe the geometry and characteristics of real world objects in a standardised way. GML can be used for storage and transport of geographic data alike. Additionally, a number of OGC web-services use GML for data exchange, especially for encoding requests and responses of Web Feature Service (WFS) and Web Coverage Service (WCS). GML offers the capabilities to enable an Internet-based infrastructure of interconnected geographic information sources and processing services. An approach that is used in local, national and international spatial data infrastructures alike.

The GML standard provides a set of rules and constructs for encoding geospatial and non-geospatial information, which can be adapted to the specific needs of a user domain. These domain specific needs then define a tailored GML application schema which defines that Community of Interests associated exchange format. These schema files define the elements and object types that can be used in a GML file and determine how the data in a GML file has to be structured (for example which elements, tags or hierarchy could be expected). This makes it possible to validate GML files against their application schema and verify if they are well formed (syntactically) and valid. Figure 1 shows the connections between the GML standard, application schemas and data instances.

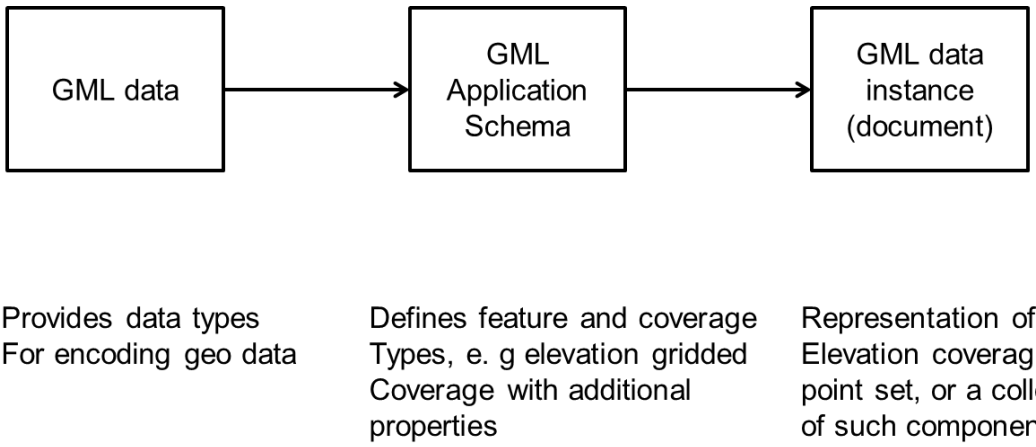

Figure F.4 – Relationship between GML standard, application schema and data instance

GML enables the encoding of a number of phenomena for example the encoding of dynamic features, spatial and temporal topology, complex geometric property types and coverages. Because it is rather unlikely that there is an application that needs all constructs offered by the GML standard, it is possible to reduce the number of supported elements and types to that required by a particular application. Therefore, GML offers the possibility of subsetting the specification by generating profiles.

Profiles of GML are generated by selecting and restricting the constructs offered by the GML standard, which are necessary to accomplish specific functions in real application systems. One GML profile could be the common basis for different application schemas of one or more user domain(s). All application schemas that conform to a specific profile have to use the same restricted capabilities. Therefore, a profile simplifies software development, increases performance and strengthens interoperability.

To define a specific GML profile, it is necessary to identify the requirements of the specific user domain(s). The GML elements and types needed for data representation have to be determined. Annex F of the GML standard provides guidelines and XSLT-scripts for sub-setting the GML schemata defined in the standard.

Figure F.2 shows the relationship between GML standard, profile and application schema. According to ISO 19136:2007 the building of an application schema is a two-part process. The profile restricts the types and elements consistent with the complete GML standard. The application schema then uses these types to define a domain specific model by extension or inclusion. In this respect, extension can be understood as defining the representation of real world objects on top of the provided GML constructs.

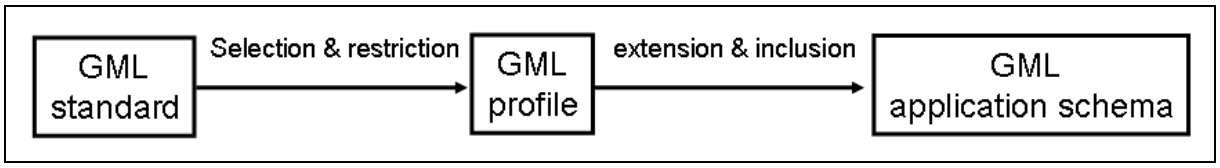

Figure F.5 – Relationship between GML standard, profile and application schema

Annex G: GML realization of the ESM UML Profiles: methodology (informative)

G.1 Procedure for generating the DGIWG GML application schemas for the DGIWG ESM UML Profiles

The ESM GML application schema is generated from ESM UML implementation model with the ShapeChange software.

The required softwares for this generation with ShapeChange are the following:

- Enterprise Architect (UML modelling software)
- ShapeChange (from http://shapechange.net/get-started/): Generation of GML schemas from UML models (use of XMI files)
    - Required software for ShapeChange : Java JDK/JRE
    - Windows command line mode (DOS / shell window)

The 4 preliminary steps for this procedure are the following:

1- Configuration of Enterprise Architect for UML to XML (see. http://www.sparxsystems.com/resources/xml_schema_generation.html)
UML Profile for XML must be imported into the UML model using the Resource View: file UML profile for XML (based on a simplified version of the INSPIRE configuration file[4], which was developed on the basis of the input from SPARXSYSTEMS http://www.sparxsystems.com/profile/XSDProfile.xml, modified into a parameterization XML file UMLProfile.xml with a change of name and id "GML for ESM"

2- Configuration of ESM UML model and application of following rules to follow on package, classes and associations

- Package : 1 unique package with stereotype « applicationSchema »
- Classes :
    - feature types with stereotype « featureType »
    - enumerations with stereotype « enumeration »
    - Class names in UpperCamelCase
- Attributes : must be public
    - Attributes names in lowerCamelCase
    - Attributes types must be defined by the model
- Associations
    - roles that must be generated in GML must be named and the cardinality specified (if # 1)
    - associations must have no stereotype, or stereotype <<association>>.

[4] with rules documented in INSPIRE document ”9.6.3 UML profile.docx”

3- Modify the UML model properties in order to define the GML tagged values allowing generation of GML schemas:

   a. Resources view, right click on each stereotype appearing in the UML profile model (here GML for ESM) + click on « Synch Tagged Value and Constraints ».

   b. Tagged Values view, select each application schema in the model to define targetNamespace, target xsd document

4- Install and Configure ShapeChange

- as explained in http://shapechange.net/get-started/
- Place UML model (.EAP file) in test folder of ShapeChange
- In the test/config folder, place and check the StandardNamespaces.xml (download if necessary from http://shapechange.net/resources/config/) and other relevant xml resources (e.g StandardMapEntries.xml and relevant related StandardMapEntries resources). Absolute path references may help to secure the generation of GML files).
- In the test/config folder, edit the config.xml fie, so as to replace all localization URL as indicated in the file. Also fill the inputFile with a reference to EAP UML model.

G.2 Generating the different GML application schemas

The last step of the procedure is the generation of the ESM GML application schema under a DOS shell window in the ShapeChange folder, as follows:

- For a 32 bits OS:

java -jar ShapeChange-2.0.0-SNAPSHOT.jar -Dfile.encoding=UTF-8 -c *<relative-path to Config.xml>*

- For a 64 bits OS:

C:\Windows\SysWOW64\java.exe -jar ShapeChange-2.0.0-SNAPSHOT.jar -Dfile.encoding=UTF-8 -c <relative-path to Config.xml>

The resulting ESM GML schema is generated in the destination folder as indicated in the config.xml file.

G.3 Adapting the generated profiles according to the specializations defined by this document

The ShapeChange tool does not catch all requirements specified automatically. The adaptation of the GML application schemas must apply the requirements defined in:

- GMLCOV for the RectifiedGridCoverage, MultiPointCoverage for the Coverage components,
- ESM1.0 for the GMLCOV::RectifiedGridCoverage Test Case, the Point Coverage Test Case and the Point Set Test Case,
- ESM1.0 for the ESM metadata resource,
- ISO 19136 / GML 3.2.1 (refer to clause A.1.4) for ESM Feature Collections.