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OGC® Coverage Implementation Schema

*(This document has been renamed from OGC® GML Application Schema – Coverages)

Warning

This document is a corrigendum to an existing OGC standard. Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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i. Preface

This document specifies a GML coverage structure extending the definition of GML 3.2.1 [07-036] in a compatible way.

Main change over GML is the addition of one mandatory component, `rangeType`, to the `Coverage` definition of GML 3.2.1 to provide a concise description of the coverage range value definition. Further, handling of format encodings different from GML are established.

This enhanced coverage type is used, for example, by the Web Coverage Service (WCS) Standard [1] version 2.0 and higher, but is independent from WCS service. This augmented coverage structure can serve a wide range of coverage application domains and service types, thereby contributing to harmonization and interoperability.

ii. Terms and definitions

This document uses the specification terms defined in Subclause 5.3 of [OGC 06-121r9], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word "shall" (not "must") is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

iii. Submitting organizations

The following organizations have submitted this Implementation Specification to the Open Geospatial Consortium, Inc.:

- ☐ Jacobs University Bremen
- ☐ National Center for Atmospheric Research (NCAR)
- ☐ Oracle USA
- ☐ PCI Geomatics Inc.
- ☐ ERDAS, Inc.
- ☐ EOX IT Services GmbH
- ☐ Spot Image
- ☐ BAE Systems - C3I Systems
- ☐ Natural Environment Research Council (NERC)
- ☐ George Mason University

iv. Document Contributor Contact Points

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v. Revision history

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2012-02-06	1.0.1	Peter Baumann, Stephan Meissl, Jinsongdi Yu	all	Established corrigendum version

vi. Changes to the OGC® Abstract Specification

The OGC® Abstract Specification does not require any changes to accommodate the technical contents of this (part of this) document.

vii. Future Work

In collaboration with the GML Standard Working Group it is foreseen to merge this Application Schema into forthcoming version 4.0 of GML.

Foreword

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Introduction

Coverages represent digital geospatial information representing space/time-varying phenomena. OGC Abstract Topic 6 [OGC 07-011] – which is identical to ISO 19123 – defines an abstract model of coverages. This is concretized by the Geography Markup Language (GML) 3.2 [07-036], an XML grammar written in XML Schema for the description of application schemas as well as the transport and storage of geographic information.

However, the definition contained in GML 3.2 has turned out to not contain sufficient information to describe coverage instances in a flexible, interoperable, and harmonized manner. To remedy this, the document on hand defines a GML Application Schema for coverages by applying the following enhancements to the GML 3.2 `Coverage` data type:

- A mandatory element `rangeType` has been added to carry information about the range value data structure of a `Coverage`.

- The property `coverageFunction`, which in GML 3.2 is associated with every sub-type of `Coverage`, is moved up into `AbstractCoverage` in the coverage type hierarchy of the standard on hand. This semantic-preserving modification does not impact instance documents.

- A metadata hook has been added which allows definition of application specific supplementary information to be transported with a coverage.

- The grid coverage types are subtypes of `AbstractCoverage` rather than being sub-types of `DiscreteCoverage` as in GML 3.2.

Further, additional coverage format encodings beyond GML are established.

This is a strict extension: no existing part of the GML 3.2 `Coverage` is changed in its syntax, nor in its semantics.

OGC® Implementation Schema for Coverages

1   Scope

This document specifies the GML coverage structure to be used by OGC standards.

2   Conformance

Standardisation target of this document are concrete **coverage instance documents**, as generated by some service and/or consumed by some client.

This document establishes four requirements classes:

- □   *gml-coverage*, of URI http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage, with a single pertaining conformance class, *gml-coverage,* of URI http://www.opengis.net/spec/GMLCOV/1.0/conf/gml-coverage. This conformance class is abstract.
- □   *gml*, of URI http://www.opengis.net/spec/GMLCOV/1.0/req/gml, with a single pertaining conformance class, *gml,* of URI http://www.open¬gis.net/spec/GML¬COV/1.0/conf/gml.
- □   *multipart*, of URI http://www.opengis.net/spec/GMLCOV/1.0/req/multipart, with a single pertaining conformance class, *multipart,* of URI http://www.open¬gis.net/spec/GMLCOV/1.0/conf/multipart.
- □   *special-format*, of URI http://www.opengis.net/spec/GMLCOV/1.0/req/special-format with a single pertaining conformance class, *special-format,* of URI http://www.open¬gis.net/spec/GMLCOV/1.0/conf/special-format.

Any implementation claiming conformance with this GMLCOV standard must conform to the abstract conformance class *gml-coverage* and, in addition, at least one of the concrete conformance classes *gml*, *multipart*, and *special-format*.

Requirements and conformance test URIs defined in this document are relative to http://www.opengis.net/spec/GMLCOV/1.0/.

Annex A lists the conformance tests which shall be exercised on any software artefact claiming to implement a conformance class of this Application Schema.

3   Normative references

This *OGC GML Application Schema for Coverages* specification consists of the present document and an XML Schema including Schematron constraints. The complete specification is identified by OGC URI http://www.opengis.net/spec/GMLCOV/1.0, the document has OGC URI http://www.opengis.net/doc/AppSchema/GMLCOV/1.0.

The complete specification is available for download from http://www.opengeospatial.org/standards/wcs additionally, the XML Schema is posted

online at **http://schemas.opengis.net/gmlcov/1.0** as part of the OGC schema repository. In the event of a discrepancy between bundled and schema repository versions of the XML Schema files, the schema repository shall be considered authoritative.

The following normative documents contain provisions (conformance classes) that, through reference in this text, constitute provisions of this specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

OGC 07-011 *Abstract Specification Topic 6: The Coverage Type and its Subtypes*, version 7.0 (identical to ISO 19123:2005)
　　Conformance classes used:
- Simple coverage interface
- Discrete coverage interface
- Thiessen polygon coverage interface
- Quadrilateral grid coverage interface
- Hexagonal grid coverage interface
- TIN coverage interface
- Segmented curve coverage interface
- Discrete coverage interchange
- Thiessen polygon coverage interchange
- Quadrilateral grid coverage interchange
- Hexagonal grid coverage interchange
- TIN coverage interchange
  - Segmented curve coverage interchange

OGC 07-036, *Geography Markup Language (GML) Encoding Standard*, version 3.2.1
　　Conformance classes used:
- GML application schemas defining coverages
  - GML documents

OGC 08-094, *OGC® SWE Common Data Model Encoding Standard*, version 2.0
　　Conformance classes used:
- Core
- UML models
  - XML Schema

4　Terms and definitions

For the purposes of this document, the terms and definitions given in the above references apply. In addition, the following terms and definitions apply.

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4.1 coverage

feature that acts as a function to return values from its range for any direct position within its spatiotemporal domain [OGC 07-011]

4.2 GML coverage

feature which is a subclass (specialization) of a `Coverage` as defined in the GML Application Schema for Coverages [OGC 09-146r1]

5 Conventions

5.1 Use of term "coverage"

The definition of "coverage" in Subclause 4.1 is the generic one provided by Abstract Topic 6 [OGC 07-011]. The term "GML coverage" is coined to denote the concrete data structure defined in the document on hand, relying on GML 3.2.1 [OGC 07-036] and SWE Common 2.0 [OGC 08-094].

For the remainder of this document, "coverage" shall be understood as a shorthand for "GML coverage" unless explicitly stated otherwise.

5.2 UML notation

All the diagrams that appear in this specification are presented using the Unified Modeling Language (UML) static structure diagram, as described in Subclause 5.2 of OGC Web Service Common [OGC 06-121r9]. Further, the following conventions hold:

- UML elements having a package name of `GML` are those defined in the UML model of GML 3.2.1 [OGC 07-036].

- UML elements having a package name of "`SWE Common`" are those defined in the UML model of SWE Common 2.0 [OGC 08-094].

- UML elements not qualified with a package name are those defined in this Application Schema.

5.3 Namespace prefix conventions

The namespace prefixes used in this document are **not** normative and are merely chosen for convenience; they may appear in examples without being formally declared, and have no semantic significance. The namespaces to which the prefixes correspond are normative, however.

Table 1   Namespace mapping conventions

Prefix	Namespace URI	Description
gml	http://www.opengis.net/gml/3.2	GML 3.2.1
swe	http://www.opengis.net/swe/2.0	SWE Common 2.0
gmlcov	http://www.opengis.net/gmlcov/1.0	GML Application Schema for Coverages 1.0

6   Coverage Model

This Clause specifies the changes over the GML 3.2.1 coverage model and the components adopted from the SWE Common data model. As such, Clause 6 establishes an abstract conformance class whereby "abstract" denotes that a concrete program must implement one of the concrete conformance classes in addition to claim conformance with this standard.

NOTE   Although this Clause 6 heavily makes use of GML, it does not prescribe that a coverage instance document be encoded in GML. A GML encoding of such coverage structures is established in conformance class *gml*.

6.1   Overview

In GML 3.2.1, all coverage types are derived from the abstract `Coverage` data type. This structure contains a `domainSet` describing the coverage's domain and a `rangeSet` component containing the range values ("pixels", "voxels") of the coverage. This Application Schema extends GML 3.2.1 [OGC 07-036] class `Coverage` with two components, `rangeType` and `metadata`.

□   The `rangeType` element describes the coverage's range set data structure. A range value often consists of one or more fields (in remote sensing also referred to as *bands* or *channels*), however, much more general definitions are possible. Range value structure description is based on the SWE Common [OGC 08-094] `DataRecord`.

□   The abstract coverage definition is augmented with an extensible slot for metadata. The intended use is to define concrete metadata structures and their semantics in extensions or application profiles.

The following changes apply over the GML 3.2.1 [OGC 07-036] specification:

□   The property `coverageFunction`, which in GML 3.2.1 [OGC 07-036] is associated with every subtype of `Coverage`, is moved up into `Coverage` in the coverage type hierarchy of the standard on hand.

   NOTE   This way, the coverage function is available in any subtype of `Coverage`. This serves to prepare for continuous coverages, like in the case described next.

□   The grid coverage types are subtypes of `Coverage` rather than being subtypes of `DiscreteCoverage` as in GML 3.2.1 [OGC 07-036].

NOTE   This allows representing not only discrete grid coverages, but also continuous coverages by using grids for the reference points in conjunction with a coverage function defining interpolation.

No further changes over GML 3.2.1 [OGC 07-036] are made in this document. In particular, no pre-existing component changes its semantics.
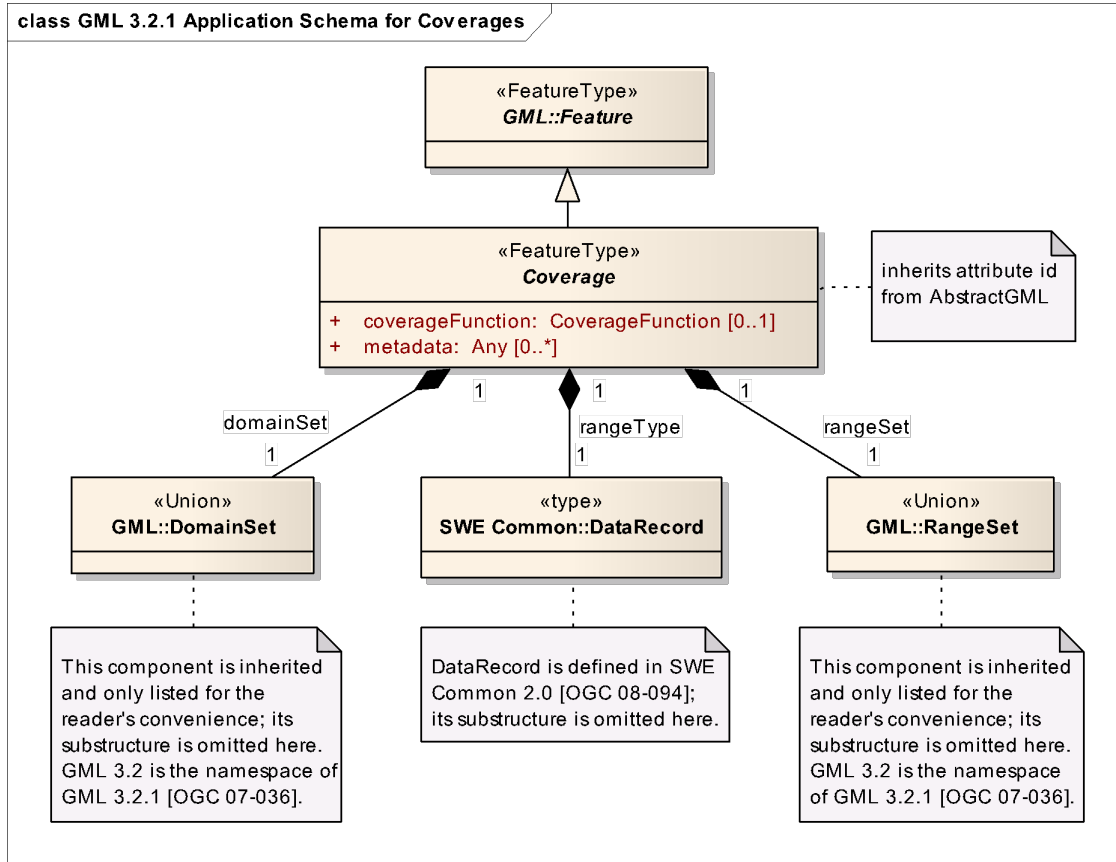
Figure 1: The `Coverage` structure

For the standard on hand, `Coverage` shall always refer to the definition of this Application Schema and *not* to the GML definition of the same name, unless explicitly stated otherwise.

Figure 1 shows the UML diagram pertaining to this Application Schema.

Requirement 1   /req/gml-coverage/structural-adherence:
Any XML document instantiating a concrete subtype of `Coverage` **shall** conform with the UML diagram in Figure 1, with Table 2, and with the XML schema defined as part of this standard.

Table 2   The `Coverage` data structure

Name	Definition	Data type	Multiplicity
coverage-Function	GML 3.2.1 coverage function to describe how range values at cov-	GML::Coverage-	Zero or one (optional)

	erage locations can be obtained	Function	
metadata	Application specific metadata	Any	Zero or more (optional)
domainSet	GML 3.2.1 Definition of coverage domain	GML:: DomainSet	One (mandatory)
rangeType	Structure definition of the coverage range values	SWE:: DataRecord	One (mandatory)
rangeSet	GML 3.2.1 Coverage range values	GML:: RangeSet	One (mandatory)

NOTE 1   The optional element gml:Envelope serves to establish a bounding box of the coverage on hand. For a purely spatial coverage, gml:Envelope is appropriate. In case the coverage also has a spatial axis, gml:Envelope can be substituted by a gml:EnvelopeWithTimePeriod; in case of a purely temporal coverage, spatial dimension in gml:EnvelopeWithTimePeriod will be zero.

NOTE 2   UML data type Any is used here with the same meaning as XML's xsd:any, which does not have a direct equivalent in UML.

NOTE 3   Following the GML pattern described in [OGC 07-036], on GML level SWE:: Data-Record is linked to rangeType via an association SWE::DataRecordPropertyType.

6.2   CoverageFunction

The coverageFunction component is identical in its syntax and meaning to the coverage-Function element defined in GML [OGC 07-036] Subclause 19.3.11.

6.3   Metadata

The metaData component is a carrier for any kind of application dependent metadata. Hence, no requirements are imposed here.

6.4   RangeType

The rangeType component adds a structure description and technical metadata required for an appropriate (however, application independent) understanding of a coverage. For this structure description, the SWE Common DataRecord is used.

Requirement 2   /req/gml-coverage/dataRecord:
The range type component of a coverage **shall** conform with the DataRecord of SWE Common [OGC 08-094].
Dependency: [OGC 08-094] Clause 7 (http://www.opengis.net/doc/SWE/2.0/clause/7), [OGC 08-094] Clause 8 (http://www.opengis.net/doc/SWE/2.0/clause/8),

NOTE   Following GML patterns the swe:DataRecord is linked into gmlwcs:Abstract-CoverageType via swe:DataRecordPropertyType.

Atomic data types available for range values are those given by the SWE Common data type `AbstractSimpleComponent`. As a range structure contains only structure definitions, but not the values themselves (these sit in the coverage range set component), the optional `AbstractSimpleComponent` component `value` is suppressed in coverages.

Requirement 3 /req/gml-coverage/no-value-in-rangeType:
For all SWE Common `AbstractSimpleComponent` subtypes in a range type structure, instance multiplicity of the `value` component **shall** be zero.

NOTE   Following [OGC 08-094], omission of the `value` component implies that in a `DataArray` there is no `encoding` component either.

Range values can be structured as records or arrays. Both structuring principles can be nested (and mixed) to any depth for a concrete coverage range structure definition.

Requirement 4 /req/gml-coverage/record-or-dataArray:
Wherever the SWE Common XML schema allows an `AbstractDataComponent` in a coverage range structure the concrete instance **shall** be one of the `AbstractDataComponent` subtypes `DataRecord` and `DataArray`.

NOTE   In particular, these `AbstractDataComponent` subtypes are not allowed in range structures: `DataChoice`, `Vector`, `Matrix`.

Within a `DataRecord` contained in a concrete range structure, each of its record components is locally uniquely identified by the record component's `field` attribute, in accordance with the "soft-typing" property introduced by SWE Common.

Example   The following XML fragment represents a valid range structure; it models the red, green, and blue channel of a Landsat scene. Pixels are defined as unsigned 8-bit quantities where 0 and 255 denote null values:

```
<rangeType>
  <swe:DataRecord>
    <swe:field name="red">
      <swe:Quantity definition="http://opengis.net/def/property/OGC/0/Radiance">
        <gml:description>Red Channel</gml:description>
        <gml:name>Red</gml:name>
        <swe:nilValues>
          <swe:NilValues gml:id="NIL_VALUES">
            <swe:nilValue
              reason="http://www.opengis.net/def/nil/OGC/0/BelowDetectionRange">
              0
            </swe:nilValue>
            <swe:nilValue
              reason="http://www.opengis.net/def/nil/OGC/0/AboveDetectionRange">
              255
            </swe:nilValue>
          </swe:NilValues>
        </swe:nilValues>
        <swe:uom code="W/cm2"/>
        <swe:constraint>
          <swe:AllowedValues>
            <swe:interval>0 255</swe:interval>
            <swe:significantFigures>3</swe:significantFigures>
```

```
              </swe:AllowedValues>
            </swe:constraint>
          </swe:Quantity>
        </swe:field>
        <swe:field name="green">
          <swe:Quantity definition="http://opengis.net/def/property/OGC/0/Radiance">
            <gml:description>Green Channel</gml:description>
            <gml:name>Green</gml:name>
            <swe:nilValues xlink:href="#NIL_VALUES"/>
            <swe:uom code="W/cm2"/>
            <swe:constraint xlink:href="#VALUE_SPACE"/>
          </swe:Quantity>
        </swe:field>
        <swe:field name="blue">
          <swe:Quantity definition="http://opengis.net/def/property/OGC/0/Radiance">
            <gml:description>Blue Channel</gml:description>
            <gml:name>Blue</gml:name>
            <swe:nilValues xlink:href="#NIL_VALUES"/>
            <swe:uom code="W/cm2"/>
            <swe:constraint xlink:href="#VALUE_SPACE"/>
          </swe:Quantity>
        </swe:field>
      </swe:DataRecord>
</rangeType>
```

6.5 RangeSet coherence

Both `domainSet` and `rangeType` describe the coverage values given in the `rangeSet`. Hence, consistency must be enforced between them. The pertaining requirements are listed in this Subclause.

Requirement 5 /req/gml-coverage/one-range-value-per-position:
For each coordinate position contained in the domain set description of a coverage there **shall** exist exactly one range value in the coverage's range set.

NOTE   Both duplicates and values omitted are not allowed. For range values not known for some reason nil values can be used.

Requirement 6 /req/gml-coverage/range-structure-consistency:
All range values contained in the range set of a coverage **shall** be consistent with the structure description provided in its range type.

6.6 Specific coverage types

This standard supports all coverage types which GML 3.2.1 [OGC 07-036] supports, which implement the discrete coverage types defined in ISO 19123 (listed in parenthesis). The supported types are substitutable from `Coverage` and include:

- ☐ `MultiPointCoverage` (ISO 19123: `CV_DiscretePointCoverage`)

- ☐ `MultiCurveCoverage` (ISO 19123: `CV_DiscreteCurveCoverage`)

- ☐ `MultiSurfaceCoverage` (ISO 19123: `CV_DiscreteSurfaceCoverage`)

□   `MultiSolidCoverage` (ISO 19123: `CV_DiscreteSolidCoverage`)

□   `GridCoverage` (ISO 19123: `CV_DiscreteGridPointCoverage`)

□   `RectifiedGridCoverage` (ISO 19123: `CV_DiscreteGridPointCoverage`)

□   `ReferenceableGridCoverage` (added to GML via Change Request [OGC 07-112r3])

The above coverage types may be used as is, or new coverage types may be constructed by using or deriving from one of the subtypes of `Coverage` or one of its subtypes.

Requirement 7   /req/gml-coverage/coverage-derivation:
The type of the root element of a coverage document instance **shall** be a concrete direct or indirect subtype of `Coverage`.

Figure 2 shows the UML diagram of the coverage hierarchy.

NOTE   As in GML, continuous coverages are not currently supported. Consequently, `ContinuousCoverage` does not have any concrete subtype.

6.6.1 DiscreteCoverage

The domain set of a discrete coverage consists of either spatial or temporal geometry objects, finite in number. The range set is comprised of a finite number of attribute values each of which is associated to every direct position within any single spatiotemporal object in the domain. In other words, the range values are constant on each spatiotemporal object in the domain. This coverage function maps each element from the coverage domain to an element in its range.

This class serves as the head of a specialization hierarchy which contains `MultiPointCoverage`, `MultiCurveCoverage`, `MultiSurfaceCoverage`, and `MultiSolidCoverage`.

NOTE   In GML 3.2.1 [OGC 07-036] grid coverages are contained in this class hierarchy as well based on a distinction between discrete and continuous coverages which is not considered state of the art any more. This Application Schema changes the hierarchy in that coverages are put separately, allowing to model continuous grid coverages.
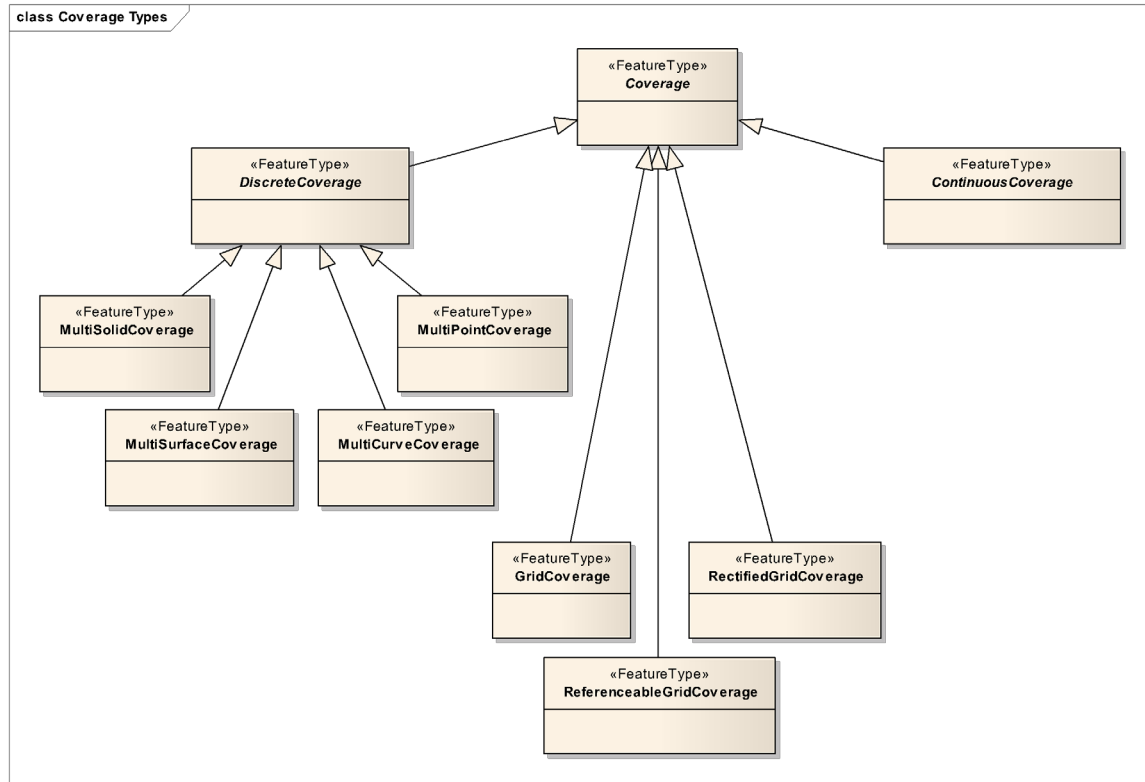
Figure 2: The `Coverage` type hierarchy

6.6.2 ContinuousCoverage

A continuous coverage as defined in ISO 19123 is a coverage that can return different values for the same feature attribute at different direct positions within a single spatiotemporal object in its spatiotemporal domain. The base type for continuous coverages is `Continuous-Coverage`.

Abstract class `ContinuousCoverage` serves as the head of a substitution group which may contain any continuous coverage whose type is derived from `ContinuousCoverage`. It parallels `GML::ContinuousCoverage`, except that the `coverageFunction` element has been moved "up" into `Coverage`.

NOTE   This GML handling of continuous coverages is under reconsideration, therefore use of `ContinuousCoverage` is not encouraged. The various grid coverage types (see Subclause 6.6.7ff) allow already modelling certain types of continuous coverages.

6.6.3 MultiPointCoverage

In a `MultiPointCoverage` the domain set is a `GM_MultiPoint`, that is a collection of arbitrarily distributed geometric points.

Requirement 8   /req/gml-coverage/multiPointCoverage:
A coverage of type `MultiPointCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have `GML::MultiPoint` values.

In the GML representation of a `MultiPointCoverage` the mapping from the domain to the range is straightforward:

☐ For `gml:DataBlock` encodings the points of the `gmlcov:MultiPoint` are mapped in document order to the tuples of the data block.

☐ For `gml:CompositeValue` encodings the points of the `gmlcov:MultiPoint` are mapped to the members of the composite value in document order.

☐ For `gml:File` encodings the points of the `gmlcov:MultiPoint` are mapped to the records of the file in sequential order.

6.6.4 MultiCurveCoverage

In a `MultiCurveCoverage` the domain is partitioned into a collection of curves comprising a `GM_MultiCurve`. The coverage function then maps each curve in the collection to a value in the range set.

Requirement 9 /req/gml-coverage/multiCurveCoverage:
A coverage of type `MultiCurveCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have "`GML 3.2`"`::MultiCurve` values.

In the GML representation of a `MultiCurveCoverage` the mapping from the domain to the range is straightforward:

☐ For `gml:DataBlock` encodings the curves of the `gmlcov:MultiCurve` are mapped in document order to the tuples of the data block.

☐ For `gml:CompositeValue` encodings the curves of the `gmlcov:MultiCurve` are mapped to the members of the composite value in document order.

☐ For `gml:File` encodings the curves of the `gmlcov:MultiCurve` are mapped to the records of the file in sequential order.

6.6.5 MultiSurfaceCoverage

In a `MultiSurfaceCoverage` the domain is partitioned into a collection of surfaces comprising a `GM_MultiSurface`. The coverage function maps each surface in the collection to a value in the range set.

Requirement 10 /req/gml-coverage/multiSurfaceCoverage:
A coverage of type `MultiSurfaceCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have `GML::MultiSurface` values.

In the GML representation of a `MultiSurfaceCoverage` the mapping from the domain to the range is straightforward:

☐ For `gml:DataBlock` encodings the surfaces of the `gmlcov:MultiSurface` are mapped in document order to the tuples of the data block.

☐ For `gml:CompositeValue` encodings the surfaces of the `gmlcov:MultiSurface` are mapped to the members of the composite value in document order.

☐ For `gml:File` encodings the surfaces of the `gmlcov:MultiSurface` are mapped to the records of the file in sequential order.

6.6.6 MultiSolidCoverage

In a `MultiSolidCoverage` the domain is partitioned into a collection of solids comprising a `GM_MultiSolid`. The coverage function then maps each solid in the collection to a value in the range set.

Requirement 11 /req/gml-coverage/multiSolidCoverage:
A coverage of type `MultiSolidCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have `GML::MultiSolid` values.

In the GML representation of a `MultiSolidCoverage` the mapping from the domain to the range is straightforward:

☐ For `gml:DataBlock` encodings the solids of the `gmlcov:MultiSolid` are mapped in document order to the tuples of the data block.

☐ For `gml:CompositeValue` encodings the solids of the `gmlcov:MultiSolid` are mapped to the members of the composite value in document order.

☐ For `gml:File` encodings the solids of the `gmlcov:MultiSolid` are mapped to the records of the file in sequential order.

6.6.7 GridCoverage

A `GridCoverage` is a discrete point coverage in which the domain is a geometric grid of points encoded using `gml:Grid` (not its subtypes `gml:RectifiedGrid` or a subtype of `AbstractReferenceableGrid`). Note that this is similar to the `MultiPointCoverage` except that a `gml:Grid` shall be used to describe the domain.

Requirement 12 /req/gml-coverage/gridCoverage:
A coverage of type `GridCoverage` shall have a domain that is a `GML::Grid`.

NOTE   Such geometric positioning is introduced in the `RectifiedGridCoverage`.

In order to address ambiguities in the `gml:Grid` definition, this GML Application Schema for Coverages imposes additional constraints on the use of a `gml:Grid` within a `gmlcov:GridCoverage`. (Specifically, there is no provision in the definition of `gml:Grid` definition to express the relationship between the grid positions and this geometry's coordinate reference system, which will always exist in some contexts, such as a Web Coverage Service. This coordinate reference system will be explicitly referenced in the `srsName` attribute of

the `gml: SRSReferenceGroup` of `gml:Grid`, or be inherited from an enclosing container element, such as the `gml:Envelope` of this `gmlcov:GridCoverage`.) Since provision for expressing a relationship does not exist, whenever used in `gmlcov:GridCoverage`, the relationship shall be simple. In this simple relationship, the dimension attribute of the `gml:Grid` shall be identical to the dimension of the geometry's coordinate system, the axes of the `gml:Grid` shall be identical to the axes of the geometry's coordinate system (which requires that the `axisLabels` be identical to those in the coordinate system definition), and the limits shall be treated as being expressed as coordinates in the geometry's coordinate reference system.

Clearly these additional constraints are quite limiting, in that gridded datasets whose Reference points happen to exist exactly at integral coordinates of a spatial coordinate system at a spacing of exactly one in all coordinate dimensions are exceedingly rare, unless that coordinate system is part of a `gml:ImageCRS`. Nevertheless, the `gmlcov:GridCoverage` is available for such purposes.

It is recommended that the more sensible provisions of the `gmlcov:RectifiedGridCoverage` or `gmlcov:ReferenceableGridCoverage` be utilized for all gridded datasets, since their domains can accommodate the simple provisions of the `gmlcov:GridCoverage` as well as more complex referencing situations.

Since this `GridCoverage` uses `Coverage`, it can be used for both discrete and continuous coverages.

6.6.8 RectifiedGridCoverage

A `RectifiedGridCoverage` is a discrete point coverage based on a rectified grid. It is similar to the grid coverage except that the points of the grid are geometrically referenced.

Requirement 13 /req/gml-coverage/rectifiedGridCoverage:
A coverage of type `RectifiedGridCoverage` **shall** have a domain that is a `GML::RectifiedGrid` geometry.

Since this `RectifiedGridCoverage` uses `Coverage`, it can be used for both discrete and continuous coverages.

6.6.9 ReferenceableGridCoverage

A `ReferenceableGridCoverage` is an implementation of ISO 19123 `DiscreteGridPointCoverage` for a `ReferenceableGrid` domain.

Requirement 14 /req/gml-coverage/referenceableGridCoverage:
A coverage of type `ReferenceableGridCoverage` **shall** have a domain geometry that is a subtype of `AbstractReferenceableGrid`.

Since this `ReferenceableGridCoverage` uses the `gmlcov:AbstractCoverageType`, it can be used for both discrete and continuous coverages.

NOTE   The equivalent of this element has been added to GML 3.2.1 by approved Change Request 07-112r3 and, therefore, has been added to this standard as well.

6.7   Complete coverage example

Example   The following is a complete `RectifiedGridCoverage` instance:

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<gmlcov:RectifiedGridCoverage
  xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xsi:schemaLocation=
     "http://www.opengis.net/gmlcov/1.0 http://schemas.opengis.net/gmlcov/1.0/gmlcovAll.xsd"
  gml:id="C001">
<gml:boundedBy>
   <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSG/0/4326" axisLabels="Lat Long"
     uomLabels="deg deg" srsDimension="2">
     <gml:lowerCorner>1 1</gml:lowerCorner>
     <gml:upperCorner>3 3</gml:upperCorner>
   </gml:Envelope>
</gml:boundedBy>
<gml:domainSet>
   <gml:RectifiedGrid gml:id="RG001_C001"
     srsName="http://www.opengis.net/def/crs/EPSG/0/4326" axisLabels="Lat Long"
     uomLabels="deg deg" dimension="2">
     <gml:limits>
        <gml:GridEnvelope>
           <gml:low>0 0</gml:low>
           <gml:high>9999 9999</gml:high>
        </gml:GridEnvelope>
     </gml:limits>
     <gml:axisLabels>Lat Long</gml:axisLabels>
     <gml:origin>
        <gml:Point gml:id="P001_C001" srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
           <gml:pos>99. 99.9</gml:pos>
        </gml:Point>
     </gml:origin>
     <gml:offsetVector>1 0</gml:offsetVector>
     <gml:offsetVector>0 1</gml:offsetVector>
   </gml:RectifiedGrid>
</gml:domainSet>
<rangeType>
   <swe:DataRecord>
     <swe:field name="white">
        <swe:Quantity definition="http://opengis.net/def/property/OGC/0/Radiance">
           <gml:description>Panchromatic</gml:description>
           <gml:name>White</gml:name>
           <swe:nilValues>
              <swe:nilValue reason="http://www.opengis.net/def/nil/OGC/0/BelowDetectionRange">
                 0
              </swe:nilValue>
              <swe:nilValue reason="http://www.opengis.net/def/nil/OGC/0/AboveDetectionRange">
                 255
              </swe:nilValue>
           </swe:nilValues>
           <swe:uom code="W/cm2"/>
           <swe:constraint>
```

```
            <swe:AllowedValues>
               <swe:interval>0 255</swe:interval>
               <swe:significantFigures>3</swe:significantFigures>
            </swe:AllowedValues>
         </swe:constraint>
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</rangeType>
<gml:coverageFunction>
  <gml:GridFunction>
    <gml:sequenceRule axisOrder="+1 +2">Linear</gml:sequenceRule>
    <gml:startPoint>0 0</gml:startPoint>
  </gml:GridFunction>
</gml:coverageFunction>
<gml:rangeSet>
  <DataBlock>
    <rangeParameters/>
    <tupleList>
        1 2 3 4 5
        6 7 8 9 10
        11 12 13 14 15
    </tupleList>
  </DataBlock>
</gml:rangeSet>
</gmlcov:RectifiedGridCoverage>
```

7 GML representation requirements class

Requirements class *gml-coverage* establishes how coverages are represented in the GML encoding format. Its identifying URL is given by http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

NOTE   Clause 6 establishes a conceptual model of a coverage, independent form its encoding. While UML and GML are used for establishing this, Clause 6 does not anticipate a GML encoding. A GML representation is established by this Clause 7 instead.

Requirement 15 /req/gml/coverage:
In a coverage encoded in GML, the coverage structure represented **shall** conform with conformance class *gml-coverage*.
Dependency: http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

Requirement 16 /req/gml/content-type:
In a coverage encoded in GML, the IETF RFC 2387 `Content-Type` parameter of this coverage document **shall** have a value of "application/gml+xml"**.**

Requirement 17 /req/gml/special-format:
A coverage document **shall** be conformant with OCG GML [07-036] conformance class A.1.9.
Dependency: OCG GML [07-036] conformance class A.1.9.

8   Multipart representation requirements class

8.1   Coverages as multipart messages

A coverage can be represented as a multipart/related message document [4] consisting of a GML-encoded part containing the coverage data minus its range set followed by a second part containing an encoding of the coverage range set in some standard encoding format. This establishes requirements class *multipart*. Its identifying URL is given by http://www.opengis.net/spec/GMLCOV/1.0/req/multipart.

NOTE   This encoding type describes a self-contained coverage document. The *gml-coverage* conform-ance class, as per GML specification, additionally allows a remote URL to be used for referencing coverage constituents. The difference between both encodings is that coverages conforming to *gml-coverage* are a single GML document containing references to any other place, resolvable by the reader in any context, whereas a *multipart* coverage contains all constituents as sub-documents in the file itself.

Requirement 18 /req/multipart/coverage:
In a coverage encoded in a multipart message, the coverage structure represented **shall** conform with conformance class *gml-coverage*.
Dependency: http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

Requirement 19 /req/multipart/multipart-mime:
A coverage encoded in a multipart message **shall** consist of a multipart MIME document as specified by IETF RFC 2387 [4].

Requirement 20 /req/multipart/content-type:
In a coverage encoded in a multipart message, the IETF RFC 2387 `Content-Type` parameter of this coverage document **shall** have a value of "`Multipart/Related`"**.**

Requirement 21 /req/multipart/number-of-components:
A coverage encoded in a multipart message **shall** consist of two parts**.**

Requirement 22 /req/multipart/start:
In a coverage encoded in a multipart message, the IETF RFC 2387 [4] `Type` parameter of this coverage document **shall** have a value of "application/gml+xml"**.**

8.2   First part: GML coverage

Requirement 23 /req/multipart/gml-coverage:
In a coverage encoded in a multipart message, the first part **shall** consist of a GML document of type `gmlcov:AbstractCoverageType`.

Requirement 24 /req/multipart/use-file:
In a coverage encoded in a multipart message, in the first part the `/gmlcov:Abstract-Coverage/gml:rangeSet` element **shall** contain a `gml:File` element.

Requirement 25 /req/multipart/rangeParameters-role:
In a coverage encoded in a multipart message, in the first part the `/gmlcov:Abstract-Coverage/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:role` attribute **shall** contain the URL identifier of a conformance class of an OGC data encoding standard.

Requirement 26 /req/multipart/rangeParameters-arcrole:
In a coverage encoded in a multipart message, in the first part the `/gmlcov:Abstract-Coverage/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:arcrole` attribute **shall** contain the value "`fileReference`".

Requirement 27 /req/multipart/rangeParameters-href:
In a coverage encoded in a multipart message, in the first part the `/gmlcov:Abstract-Coverage/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:href` attribute **shall** contain a value identical to `/gmlcov:AbstractCoverage/gml:range-Set/gml:File/gml:fileReference` contents.

Requirement 28 /req/multipart/fileReference:
In a coverage encoded in a multipart message, in the first part the `/gmlcov:Abstract-Coverage/gml:rangeSet/gml:File/gml:fileReference` element **shall** contain a local "cid" (Content-ID) URL as specified by IETF RFC 2392 [5] to the second part of the multipart message..

Example   The following MIME message represents a valid multipart coverage structure (assuming all "..." substituted by proper XML and with a proper TIFF file instead of the second-to-last line):

```
Content-Type: Multipart/Related; boundary=wcs;
        start="GML-Part"
        type="text/xml"
--wcs
Content-type: text/xml
Content-ID: GML-Part
<?xml version="1.0" …>
<gmlcov:RectifiedGridCoverage …>
<gml:domainSet>…</gml:domainSet>
  <gml:rangeSet>
    <gml:File>
      <gml:rangeParameters xlink:href="grey.tif"
       xlink:role="http://www.opengis.net/spec/WCS_coverage-
encoding_geotiff/1.0/"
       xlink:arcrole="fileReference"/>
      <gml:fileReference>grey.tif</gml:fileReference>
      <gml:fileStructure/>
      <gml:mimeType>image/tiff</gml:mimeType>
    </gml:File>
  </gml:rangeSet>
  <gmlcov:rangeType>…</gmlcov:rangeType>
</gmlcov:RectifiedGridCoverage>
--wcs
Content-Type: image/tiff
Content-Description: coverage data
Content-Transfer-Encoding: binary
Content-ID: grey.tif
Content-Disposition: INLINE
...binary TIFF data...
--wcs--
```

Requirement 29 /req/multipart/mimeType:
In a coverage encoded in a multipart message, in the first part the `/gmlcov:Abstract-`

Coverage/gml:rangeSet/gml:File/gml:mimeType **shall** contain that MIME type string which is defined in the standard referenced in the /gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:role attribute.

NOTE   The contents of the gml:File/gml:compression element is left undefined as this element is currently not used by this standard.

8.3   Second part: encoded coverage range set

Requirement 30 /req/multipart/target-content-disposition:
In a coverage encoded in a multipart message, the IETF RFC 2387 [4] Content-Disposition parameter of this coverage document **shall** be present and have a value of "inline" (not case sensitive)**.**

NOTE   This follows IETF RFC 2183 [6].

Requirement 31 /req/multipart/target-mimetype:
In a coverage encoded in a multipart message the MIME type identifier of the second part **shall** be identical to the value of /gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:mimeType in the first part of the multipart coverage.

Requirement 32 /req/multipart/target-encoding:
In a coverage encoded in a multipart message the second part **shall** conform to the encoding specified in the /gmlcov:AbstractCoverage/gml:File/gml:rangeParameters/@xlink:role value in the first part of the multipart coverage.

Requirement 33 /req/multipart/consistent:
In a coverage encoded in a multipart message the coverage components encoded in the second message part, when decoded from the format on hand into GML, **shall** be consistent with the coverage components of the first part of the multipart coverage.
Dependency: http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

Example   The following sketches a valid multipart coverage (contents of second part omitted):

```
Content-Type: Multipart/Related; boundary=wcs;
        start="GML-Part"
        type="application/gml+xml"

--wcs
Content-type: application/gml+xml
Content-ID: GML-Part

<?xml version="1.0" encoding="UTF-8"?>
<gmlcov:RectifiedGridCoverage xmlns:wcs="http://www.opengis.net/wcs/2.0"
xmlns:ows="http://www.opengis.net/ows/2.0"
xmlns:ogc="http://www.opengis.net/ogc"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:swe="http://www.opengis.net/swe/2.0"
xsi:schemaLocation="http://www.opengis.net/wcs/2.0
http://schemas.opengis.net/wcs/2.0/wcsAll.xsd " gml:id="grey">
```

```xml
<gml:boundedBy>
  <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSG/0/32611"
axisLabels="x y" uomLabels="m m" srsDimension="2">
    <gml:lowerCorner>5 5</gml:lowerCorner>
    <gml:upperCorner>395 295</gml:upperCorner>
  </gml:Envelope>
</gml:boundedBy>
<gml:domainSet>
  <gml:RectifiedGrid dimension="2" gml:id="grid_grey">
    <gml:limits>
      <gml:GridEnvelope>
        <gml:low>0 0</gml:low>
        <gml:high>39 29</gml:high>
      </gml:GridEnvelope>
    </gml:limits>
    <gml:axisLabels>x y</gml:axisLabels>
    <gml:origin>
      <gml:Point gml:id="grid_origin_grey"
srsName="http://www.opengis.net/def/crs/EPSG/0/32611">
        <gml:pos>5.000000 5.000000</gml:pos>
      </gml:Point>
    </gml:origin>
    <gml:offsetVector
srsName="http://www.opengis.net/def/crs/EPSG/0/32611">10.000000
0</gml:offsetVector>
    <gml:offsetVector
srsName="http://www.opengis.net/def/crs/EPSG/0/32611">0
10.000000</gml:offsetVector>
  </gml:RectifiedGrid>
</gml:domainSet>
<gml:rangeSet>
  <gml:File>
    <gml:rangeParameters xlink:href="cid:grey.tif"
xlink:role="http://www.opengis.net/spec/WCS_coverage-
encoding_geotiff/1.0/" xlink:arcrole="fileReference"/>
    <gml:fileReference>cid:grey.tif</gml:fileReference>
    <gml:fileStructure/>
    <gml:mimeType>image/tiff</gml:mimeType>
  </gml:File>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="grey">
      <swe:Quantity defini-
tion="http://www.opengis.net/def/property/OGC/0/Radiance">
        <swe:description>Grey band</swe:description>
        <swe:nilValues/>
        <swe:uom code="W.m-2.sr-1.nm-1"/>
        <swe:constraint>
          <swe:AllowedValues>
            <swe:interval>-32768 32767</swe:interval>
          </swe:AllowedValues>
        </swe:constraint>
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
```

```
</gmlcov:RectifiedGridCoverage>
--wcs
Content-Type: image/tiff
Content-Description: coverage data
Content-Transfer-Encoding: binary
Content-ID: grey.tif
Content-Disposition: inline

--wcs--
```

9   Special format requirements class

Requirements class *special-format* establishes how coverages are represented in encoding formats other than GML. Its identifying URL is given by http://www.opengis.net/spec/GMLCOV/1.0/req/special-format.

NOTE   Such formats may be able to encode only parts of a coverage, and they may be able to encode only specific categories of coverages.

Requirement 34 /req/special/coverage:
In a coverage encoded in a multipart message, the coverage structure represented **shall** conform with conformance class *gml-coverage*.
Dependency: http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

Requirement 35 /req/special/special-format:
A coverage document not encoded in GML **shall** be conformant with some OGC data format encoding standard.
Dependency: OCG format encoding standards.

Example   A 2-D rectified grid coverage can be represented by a GeoTIFF file.

Bibliography

[1] OGC 09-110r3, *Web Coverage Service (WCS) Core Interface Standard*, version 2.0, 2010

[2] W3C Recommendation, *XML Path Language (XPath)*, version 2.0, 2007 (www.w3.org/xpath20)

[3] ISO/IEC 19757-3:2006 Information technology – Document Schema Definition Languages (DSDL) – Part 3: Rule-based validation – Schematron

[4] IETF RFC 2387, August 1998

[5] IETF RFC 2392, August 1998

[6] IETF RFC 2183, August 1997

Annex A
(normative)

Abstract test suite

This Annex specifies an Abstract Test Suite which shall be passed in completeness by any implementation claiming conformance with this Application Schema.

Tests identifiers below are relative to http://www.opengis.net/spec/GMLCOV/1.0/.

A.1 Conformance Test Class: gml-coverage

The OGC URI identifier of this conformance class is:
http://www.opengis.net/spec/GMLCOV/1.0/conf/gml-coverage.

A.1.1 Document validates

Test id:	**/conf/gml-coverage/structural-adherence**

Test Purpose:	**Requirement /req/gml-coverage/structural-adherence:** Any XML document instantiating a concrete subtype of `Coverage` **shall conform** with the UML diagram in Figure 1, with Table 2, and with the XML schema defined as part of this standard.

Test method:	If the coverage instance document is encoded in XML, load the document into an XML validator. Test passes if the document is a valid concrete sub-type of `gmlcov:AbstractCoverageType.`

A.1.2 DataRecord range structure

Test id:	**/conf/gml-coverage/dataRecord**

Test Purpose:	**Requirement /req/gml-coverage/dataRecord:** The range type component of a coverage **shall** conform with the `Data-Record` of SWE Common [OGC 08-094].

Test method:	Validate the coverage instance under test against SWE Common by evaluating its conformance test suite.

Test passes if all SWE Common tests applicable pass.

A.1.3 No value component in rangeType

Test id: **/conf/gml-coverage/no-value-in-rangeType**

Test Purpose: **Requirement /req/gml-coverage/no-value-in-rangeType:**
For all SWE Common `AbstractSimpleComponent` subtypes in a range
type structure, instance multiplicity of the `value` component **shall** be zero.

Test method: In the instance document under test, inspect all SWE Common
`AbstractSimpleComponent` subtypes in a range type structure and
check that no value component is present.

One way of doing so is to evaluate this Schematron rule:

```
<sch:rule context="//swe:Quantity |
//swe:QuantityRange |//swe:Count|//swe:CountRange |
//swe:Time | //swe:TimeRange | //swe:Boolean |
//swe:Category | //swe:CategoryRange | //swe:Text">
<sch:assert test="count(//swe:value)=0"/>
</sch:rule>
```

Test passes if constraint holds.

A.1.4 Admissible `DataRecord` subtypes

Test id: **/conf/gml-coverage/record-or-dataArray**

Test Purpose: **Requirement /req/gml-coverage/record-or-dataArray:**
Wherever the SWE Common XML schema allows an `AbstractData-`
`Component` in a coverage range structure the concrete instance **shall** be one
of the `AbstractDataComponent` subtypes `DataRecord` and
`DataArray`.

Test method: Inspect the instance document under test and check the above constraint.
One way of doing so is to evaluate this Schematron rule:

```
<sch:rule>
<sch:assert test="descendant-or-self::*
    [name()='swe:DataRecord' or
     name()='swe:DataArray']"
/>
</sch:rule>
```

Test passes if constraint holds.

A.1.5 Exactly one range value

Test id: **/conf/gml-coverage/one-range-value-per-position**

Test Purpose: **Requirement /req/gml-coverage/one-range-value-per-position:**
For each coordinate position contained in the domain set description of a coverage there **shall** exist exactly one range value in the coverage's range set.

Test method: Inspect the instance document under test and check, for each possible location as defined in the coverage's domain set, that there is exactly one corresponding value in the range set.

Test passes if all constraints evaluate to true.

A.1.6 Range values adhere to range structure definition

Test id: **/conf/gml-coverage/range-structure-consistency**

Test Purpose: **Requirement /req/gml-coverage/range-structure-consistency:**
All range values contained in the range set of a coverage **shall** be consistent with the structure description provided in its range type.

Test method: Inspect the instance document under test and check, for each range value tuple:

- Number of tuple components adheres to range structure definition.

- Data type of each atomic value conforms to the corresponding data type specification in the range structure definition.

- Value of attribute `uom` in `gml:QuantityList` in `gml:rangeSet` consistent with value of attributes `code` in `swe:uom` and `definition` in `swe:Quantity` in `gmlcov:rangeType`.

Test passes if all constraints evaluate to true.

A.1.7 Coverage type correctly derived

Test id: **/conf/gml-coverage/coverage-derivation**

Test Purpose: **Requirement /req/gml-coverage/coverage-derivation:**
The type of the root element of a coverage document instance **shall** be a concrete direct or indirect subtype of `Coverage`.

Test method: Check whether the XML type of the root element of the instance document

under test

☐ Is not abstract

☐ Is a direct or indirect subtype of `gmlcov:AbstractCoverage`.

Test passes if constraints evaluate to true.

A.1.8 Correct structure of multi-point coverage

Test id: **/conf/gml-coverage/multiPointCoverage**

Test Purpose: **Requirement /req/gml-coverage/multiPointCoverage:**
A coverage of type `MultiPointCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have `GML::MultiPoint`

Test method: Check the XML type of the root element of the instance document under test.

☐ If type is `MultiPointCoverage`: check whether the document's `domainSet` element contains values of type `gml:MultiPoint`.

☐ otherwise: pass test.

Test passes if constraints evaluate to true.

A.1.9 Correct structure of multi-curve coverage

Test id: **/conf/gml-coverage/multiCurveCoverage**

Test Purpose: **Requirement /req/gml-coverage/multiCurveCoverage:**
A coverage of type `MultiCurveCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have "`GML 3.2`"`::MultiCurve` values.

Test method: Check the XML type of the root element of the instance document under test.

☐ If type is `MultiCurveCoverage`: check whether the document's `domainSet` element contains values of type `gml:MultiCurve`.

☐ otherwise: pass test.

Test passes if constraints evaluate to true.

A.1.10 Correct structure of multi-surface coverage

Test id: **/conf/gml-coverage/multiSurfaceCoverage**

Test Purpose: **Requirement /req/gml-coverage/multiSurfaceCoverage:**
A coverage of type `MultiSurfaceCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have `GML::MultiSurface` values.

Test method: Check the XML type of the root element of the instance document under test.

- ☐ If type is `MultiSurfaceCoverage`: check whether the document's `domainSet` element contains values of type `gml:Multi-Surface`.

- ☐ otherwise: pass test.

Test passes if all constraints evaluate to true.

A.1.11 Correct structure of multi-solid coverage

Test id: **/conf/gml-coverage/multiSolidCoverage**

Test Purpose: **Requirement /req/gml-coverage/multiSolidCoverage:**
A coverage of type `MultiSolidCoverage` **shall** have a content model identical with `DiscreteCoverage`, except that the `domainSet` **shall** have `GML::MultiSolid` values.

Test method: Check the XML type of the root element of the instance document under test.

- ☐ If type is `MultiSolidCoverage`: check whether the document's `domainSet` element contains values of type `gml:MultiSolid`.

- ☐ otherwise: pass test.

Test passes if all constraints evaluate to true.

A.1.12 Correct structure of grid coverage

Test id: **/conf/gml-coverage/gridCoverage**

Test Purpose: **Requirement** A `GridCoverage` is a discrete point coverage in which the domain is a geometric grid of points encoded using `gml:Grid` (not its sub-

types `gml:RectifiedGrid` or a subtype of
`AbstractReferenceableGrid`). Note that this is similar to the `Multi-PointCoverage` except that a `gml:Grid` shall be used to describe the
domain.

/req/gml-coverage/gridCoverage:
A coverage of type `GridCoverage` shall have a domain that is a
`GML::Grid`.

Test method: Check the XML type of the root element of the instance document under
test.

   ☐ If type is `GridCoverage`: check whether the document's
`domainSet` element is a `gml:Grid.`

   ☐ otherwise: pass test.

Test passes all if constraints evaluate to true.

A.1.13 Correct structure of rectified grid coverage

Test id: **/conf/gml-coverage/rectifiedGridCoverage**

Test Purpose: **Requirement /req/gml-coverage/rectifiedGridCoverage:**
A coverage of type `RectifiedGridCoverage` **shall** have a domain that
is a `GML::RectifiedGrid` geometry.

Test method: Check the XML type of the root element of the instance document under
test.

   ☐ If type is `RectifiedGridCoverage`: check whether the docu-
ment's `domainSet` element is a `gml:RectifiedGrid.`

   ☐ otherwise: pass test.

Test passes if all constraints evaluate to true.

A.1.14 Correct structure of referenceable grid coverage

Test id: **/conf/gml-coverage/referenceableGridCoverage**

Test Purpose: **Requirement /req/gml-coverage/referenceableGridCoverage:**
A coverage of type `ReferenceableGridCoverage` **shall** have a domain
geometry that is a subtype of `AbstractReferenceableGrid.`

Test method: Check the XML type of the root element of the instance document under test.

  ☐ If type is `ReferenceableGridCoverage`: check whether the document's `domainSet` element is in the substitution group of `AbstractReferenceableGrid`.

  ☐ otherwise: pass test.

Test passes if all constraints evaluate to true.

A.2 Conformance Test Class: gml

The OGC URI identifier of this conformance class is:
http://www.opengis.net/spec/GMLCOV/1.0/conf/gml.

A.1.15 GML coverage

Test id: /conf/gml/coverage

Test Purpose: **Requirement /req/gml/coverage:**
In a coverage encoded in GML, the coverage structure represented **shall** conform with conformance class *gml-coverage*.
Dependency: http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

Test method: If the coverage instance document under test is encoded in XML, check that the coverage is a valid concrete subtype of `gmlcov:AbstractCoverageType`.

Test passes if constraint holds.

A.1.16 GML content type

Test id: /conf/gml/content-type

Test Purpose: **Requirement /req/gml/content-type:**
In a coverage encoded in GML, the IETF RFC 2387 `Content-Type` parameter of this coverage document **shall** have a value of "application/gml+xml"**.**

Test method: If the coverage instance document under test is encoded in GML, check that the IETF RFC 2387 `Content-Type` parameter of this coverage document has a value of "application/gml+xml".

Test passes if constraint holds.

A.1.17 GML special format

Test id: **/conf/gml/special-format**

Test Purpose: **Requirement /req/gml/special-format:**
A coverage document **shall** be conformant with OCG GML [07-036] conformance class A.1.9.
Dependency: OCG GML [07-036] conformance class A.1.9.

Test method: Validate the coverage document under test against OCG GML [07-036] conformance class A.1.9 test suite.

Test passes if all test applicable pass.

A.3   Conformance Test Class: multipart

The OGC URI identifier of this conformance class is:
http://www.opengis.net/spec/GMLCOV/1.0/conf/multipart.

A.1.18 Multipart coverage

Test id: **/conf/multipart/coverage**

Test Purpose: **Requirement /req/multipart/coverage:**
In a coverage encoded in a multipart message, the coverage structure represented **shall** conform with conformance class *gml-coverage*.
Dependency: http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

Test method: If the coverage under test is encoded in a multipart message, check that the instance document is a valid concrete subtype of `gmlcov:Abstract-CoverageType`.

Test passes if constraint evaluates to true.

A.1.19 Multipart mime

Test id: **/conf/multipart/multipart-mime**

Test Purpose: **Requirement /req/multipart/multipart-mime:**
A coverage encoded in a multipart message **shall** consist of a multipart MIME document as specified by IETF RFC 2387 [4].

Test method: If the coverage is encoded in a multipart message, check that the instance document consists of a multipart MIME documents.

Test passes if constraint evaluates to true.

A.1.20 Multipart content type

Test id: **/conf/multipart/content-type**

Test Purpose: **Requirement /req/multipart/content-type:**
In a coverage encoded in a multipart message, the IETF RFC 2387 `Content-Type` parameter of this coverage document **shall** have a value of "`Multipart/Related`"**.**

Test method: If the coverage under test is encoded in a multipart message, check that its IETF RFC 2387 `Content-Type` parameter has a value of "`Multipart/Related`".

Test passes if constraint evaluates to true.

A.1.21 Correct component number

Test id: **/conf/multipart/number-of-components**

Test Purpose: **Requirement /req/multipart/number-of-components:**
A coverage encoded in a multipart message **shall** consist of two parts**.**

Test method: If the coverage under test is encoded in a multipart message, check that the given coverage consists of two parts.

Test passes if constraint evaluates to true.

A.1.22 Correct multipart start

Test id: **/conf/multipart/multipart/start**

Test Purpose: **Requirement /req/multipart/start:**
In a coverage encoded in a multipart message, the IETF RFC 2387 [4] `Type` parameter of this coverage document **shall** have a value of "application/gml+xml"**.**

Test method: If the coverage under test is encoded in a multipart message, check that its IETF RFC 2387 Type parameter has a value of "application/gml+xml".

Test passes if constraint evaluates to true.

A.1.23 First part of multipart coverage

Test id: **/conf/multipart/gml-coverage**

Test Purpose: **Requirement /req/multipart/gml-coverage:**
In a coverage encoded in a multipart message, the first part **shall** consist of a GML document of type `gmlcov:AbstractCoverageType`.

Test method: If the coverage under test is encoded in a multipart message, check that its first part consists of a GML document of type `gmlcov:AbstractCoverageType`.

Test passes if constraint evaluates to true.

A.1.24 RangeSet in file

Test id: **/conf/multipart/use-file**

Test Purpose: **Requirement /req/multipart/use-file:**
In a coverage encoded in a multipart message, in the first part the `/gmlcov:AbstractCoverage/gml:rangeSet` element **shall** contain a `gml:File` element.

Test method: If the coverage under test is encoded in a multipart message, check that the given coverage is a multipart coverage and the `/gmlcov:Abstract-Coverage/gml:rangeSet` element of its first part contains a `gml:File` element.

Test passes if all constraints evaluates to true.

A.1.25 Correct rangeParameter role

Test id: **/conf/multipart/rangeParameters-role**

Test Purpose: **Requirement /req/multipart/rangeParameters-role:**
In a coverage encoded in a multipart message, in the first part the `/gmlcov:AbstractCover-age/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:role` attribute **shall** contain the URL identifier of a conformance class of an OGC data encoding standard.

Test method: If the coverage under test is encoded in a multipart message, check that its `/gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:role` attribute of the first part contains the URL identifier of a conformance class of an OGC data encoding standard.

Test passes if constraint evaluates to true.

A.1.26 Correct rangeParameters arcrole

Test id: **/conf/multipart/rangeParameters-arcrole**

Test Purpose: **Requirement /req/multipart/rangeParameters-arcrole:**
In a coverage encoded in a multipart message, in the first part the
`/gmlcov:AbstractCover-`
`age/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:`
`arcrole` attribute **shall** contain the value "`fileReference`".

Test method: If the coverage under test is encoded in a multipart message, check that its
`/gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:`
`rangeParameters/@xlink:arcrole` attribute of the first part contains
the value "`fileReference`".

Test passes if constraint evaluates to true.

A.1.27 Correct rangeParameters href

Test id: **/conf/multipart/rangeParameters-href**

Test Purpose: **Requirement /req/multipart/rangeParameters-href:**
In a coverage encoded in a multipart message, in the first part the
`/gmlcov:AbstractCover-`
`age/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:`
`href` attribute **shall** contain a value identical to `/gmlcov:Abstract-`
`Coverage/gml:rangeSet/gml:File/gml:fileReference` con-
tents.

Test method: If the coverage under test is encoded in a multipart message, check that its
`/gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:`
`rangeParameters/@xlink:href` attribute of the first part contains a
value identical to `/gmlcov:AbstractCoverage/gml:range-`
`Set/gml:File/gml:fileReference` contents.

Test passes if constraint evaluates to true.

A.1.28 Correct fileReference

Test id: **/conf/multipart/fileReference**

Test Purpose: **Requirement /req/multipart/fileReference:**
In a coverage encoded in a multipart message, in the first part the
`/gmlcov:AbstractCover-`
`age/gml:rangeSet/gml:File/gml:fileReference` element **shall**

contain a local "cid" (Content-ID) URL as specified by IETF RFC 2392 [5] to the second part of the multipart message..

Test method: If the coverage under test is encoded in a multipart message, check that its `/gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:fileReference` element of the first part contains a local "cid" (Content-ID) URL as specified by IETF RFC 2392 to access the second part of the multipart message.

Test passes if constraint evaluates to true.

A.1.29 Consistent mimeType

Test id: **/conf/multipart/mimeType**

Test Purpose: **Requirement /req/multipart/mimeType:**
In a coverage encoded in a multipart message, in the first part the `/gmlcov:AbstractCover-age/gml:rangeSet/gml:File/gml:mimeType` **shall** contain that MIME type string which is defined in the standard referenced in the `/gmlcov:AbstractCoverage/gml:range-Set/gml:File/gml:rangeParameters/@xlink:role` attribute.

Test method: If the coverage under test is encoded in a multipart message, check that its `/gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:mimeType` of the first part contains the MIME type string which is defined in the standard referenced in the `/gmlcov:AbstractCoverage/gml:rangeSet/gml:File/gml:rangeParameters/@xlink:role` attribute.

Test passes if constraint evaluates to true.

A.1.30 Correct Content-Disposition

Test id: **/conf/multipart/target-content-disposition**

Test Purpose: **Requirement /req/multipart/target-content-disposition:**
In a coverage encoded in a multipart message, the IETF RFC 2387 [4] `Content-Disposition` parameter of this coverage document **shall** be present and have a value of "`inline`" (not case sensitive)**.**

Test method: If the coverage under test is encoded in a multipart message, check that its IETF RFC 2387 `Content-Disposition` parameter of the first part presents and has a value of "`inline`" (not case sensitive).

Test passes if constraint evaluates to true.

A.1.31 Consistent target mimeType

Test id: **/conf/multipart/target-mimeType**

Test Purpose: **Requirement /req/multipart/target-mimetype:**
In a coverage encoded in a multipart message the MIME type identifier of the second part **shall** be identical to the value of `/gmlcov:Abstract-Coverage/gml:rangeSet/gml:File/gml:mimeType` in the first part of the multipart coverage.

Test method: If the coverage is encoded in a multipart message, check that the `Content-Type` of the second part is identical to the value of `/gmlcov:AbstractCoverage/gml:range-Set/gml:File/gml:mimeType`.

Test passes if constraint evaluates to true.

A.1.32 Consistent target encoding

Test id: **/conf/multipart/target-encoding**

Test Purpose: **Requirement /req/multipart/target-encoding:**
In a coverage encoded in a multipart message the second part **shall** conform to the encoding specified in the `/gmlcov:AbstractCover-age/gml:File/gml:rangeParameters/@xlink:role` value in the first part of the multipart coverage.

Test method: If the coverage under test is encoded in a multipart message, check that the `Content-Transfer-Encoding` of the second part conforms to the encoding specified in the `/gmlcov:AbstractCoverage/gml:File/gml:rangeParameters/@xlink:role` value in the first part of the multipart coverage.

Test passes if constraint evaluates to true.

A.1.33 Consistent multipart coverage

Test id: **/conf/multipart/consistent**

Test Purpose: **Requirement /req/multipart/consistent:**
In a coverage encoded in a multipart message the coverage components encoded in the second message part, when decoded from the format on hand into GML, **shall** be consistent with the coverage components of the first part of the multipart coverage.

Test method: If the coverage under test is encoded in a multipart message, decode the second message part of the multipart coverage into GML. Check that the

decoded message is consistent with the coverage components of the first part of the multipart coverage for all components present in the first part.

Test passes if constraint evaluates to true.

A.4   Conformance Test Class: special-format

The OGC URI identifier of this conformance class is:
http://www.opengis.net/spec/GMLCOV/1.0/conf/special-format.

A.1.34 Special coverage

Test id:	**/conf/special/coverage**

Test Purpose: **Requirement /req/special/coverage:**
In a coverage encoded in a multipart message, the coverage structure represented **shall** conform with conformance class *gml-coverage*.
Dependency: http://www.opengis.net/spec/GMLCOV/1.0/req/gml-coverage.

Test method: If the coverage under test is encoded in GML, check that the coverage instance document is a valid concrete subtype of `gmlcov:Abstract-CoverageType` by performing all tests of conformance class *gml-coverage* on it.

Test passes if constraint evaluates to true.

A.1.35 Special format

Test id:	**/conf/multipart/special-format**

Test Purpose: **Requirement /req/special/special-format:**
A coverage document not encoded in GML **shall** be conformant with some OGC data format encoding standard.
Dependency: OCG format encoding standards.

Test method: If the coverage under test is not encoded in GML, invoke corresponding test according to its encoding format declaration.

Test passes if the resp. format encoding conformance test passes.

-- end of ATS --