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Editors: Lucio Colaiacomo, Joan Masó, Emmanuel Devys

## OGC GML in JPEG 2000 (GMLJP2) Encoding Standard Part 1: Core

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Abstract

This standard applies to the encoding and decoding of JPEG 2000 images that contain GML for use with geographic imagery.

This document specifies the use of the Geography Markup Language (GML) within the XML boxes of the JPEG 2000 data format and provides an application schema for JPEG 2000 that can be extended to include geometrical feature descriptions and annotations. The document also specifies the encoding and packaging rules for GML use in JPEG 2000.

## **i. Preface**

This OGC encoding standard defines the means by which the Geography Markup Language (GML) is to be used within JPEG 2000 images for adding geographic content to imagery.

This standard was originally the result of work in the GML in JPEG 2000 Interoperability Experiment. In 2004, the submitting organizations introduced a candidate specification document [OGC 04-045] which later became an Open Geospatial Consortium (OGC) public Discussion Paper and the basis for conducting the Interoperability Experiment. The Activity Plan for the GML in JPEG 2000 Interoperability Experiment was formally approved by the OGC in February 2005. Version 1.0.0 of this standard was published in January of 2006.

The current revision of this standard is the result of discussions with the GMLJP2 v1.1 SWG during 2007 and 2008. These discussions were motivated by the experiences of those involved with the implementation and use of the 1.0.0 version. In essence, version 1.0 was not widely implemented, due to a loosely specified Coverage schema, loosely specified rules for the georeference mechanism, and loosely specified conformance clause based on this loose schema. Additionally, it had to compete with other solutions, such as the use of “World files” (which have some limitations for georeference information, and also need an auxiliary file) and the use of GeoJP2 (which is GeoTIFF tags inside a uuid box in JP2 format; which is a “de facto” standard with limited capabilities, whose key advantage is that it has been quickly developed, and may be quickly implemented, but would require some clarifications and additional capabilities for addressing the full scope of complex geospatial imagery). The proposal was formally reactivated in 2012 with the aim to provide a generic application schema for JPEG2000 coverage and the requirement of using the standardized GML Coverage Application Schema (GMLCOV) made available by OGC that is also used for Web Coverage Service 2.0 in replacement of the GML 3.1.1 coverage.

Intended target audience are developers intending to implement geospatially enabled JPEG2000 encoders and readers and developers of both WFS and WCS that what to provide support for JPEG2000 formats or developers that are used to GML. This document aims at providing a clear and testable set of requirements but also an overview and giving useful hints and best practices beyond the pure normative texts.

This standard is fully conformant to GML 3.2.1 standard and guidelines, and the GMLCOV application schema.

## ii. Document terms and definitions

This document uses the standard terms defined in Clause 5.3 of [OGC 06-121r3], 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.

**NOTE** Occasionally this document capitalizes “SHALL” solely to emphasize a particular requirement. No normative, semantic difference between “SHALL” and “shall” is intended.

## iii. Document contributor contact point

The following organizations submitted this document to the Open Geospatial Consortium.

Name	Organization
Emmanuel Devys	IGN, France, emmanuel.devys at ign.fr
Joan Maso	CREAF, Spain, Joan.Maso at uab.cat
Lucio Colaiacomo	EUSC SatCen, Spain, lucio.colaiacomo at satcen.europa.eu

The submitting entities are grateful for the contributions from the following organizations in the development and revisions of this standard:

- EUSC (Raul Alonso Reyes)
- GALDOS Inc. (Darko Androsevic)
- NGA (Steven Rogan)

The submitting entities are also grateful for the contributions of those listed in [OGC 05-047r3] who participated in the creation of version 1.0 of this standard.

## iv. Document contributor contact points

All questions regarding this document should be directed to the editors:

Lucio Colaiacomo  
European Union Satellite Center  
lucio.colaiacomo at satcen.europa.eu

Joan Masó Pau  
joan.maso at uab.cat  
UAB-CREAF

Emmanuel Devys  
emmanuel.devys at ign.fr  
Institut National de l'Information Géographique et  
Forestière (IGN)



## **v. Changes to the OGC Abstract Specification**

The OpenGIS® Abstract Specification does not require changes to accommodate the technical contents of this document. A mapping document between GMLCOV model and AS Topic 6 (i.e ISO 19123) may be envisaged.

## **vi. Changes to the previous version**

Changes to the previous version of this standard address the following topics.

1- This specification is based on the GMLCOV application schema as specified in OGC 09-146r2 1.0.1. (May 2012) and OGC 12-108 OGC® GML Application Schema - Coverages - JPEG2000 Coverage Encoding Extension. Some text of the previous version has been removed to avoid redundancies to these specifications.

2- MIME type and JP2 reader requirement box type for GML additional explanation: MIME type for JPEG2000 is clarified in OGC 12-108 OGC® GML Application Schema - Coverages - JPEG2000 Coverage Encoding Extension.

3- The presence of GML metadata is announced by requiring feature 67 in the reader requirements box (XMLGISMetaData). The data is then packaged in XML data which is annotated with JPX labels, where the annotation works via the "association" (ASOC) box of part 2.

4- Metadata content / profiles (e.g. EOP (Earth Observation Profile) metadata model, possibly INSPIRE, US NITF ....) and optimization in the metadata streaming capability is clarified and exemplified. This part can accommodate different profiles to enable the usage of flexible metadata in different XML boxes to provide flexibility and streaming in parallel.

5- Specification of NIL values As per OGC Project Document 08-012, see Annex B. A section clarifying the NIL values and unifying this with WCS definitions is included.

6- Clarification of the use of CRS and Rectified grid coverage / image georeference with origin point (at pixel center).

7- The relative reference meaning has been changed from previous versions of this standard.

8- This specification includes an application schema that extends GMLCOV application schema. This avoids the need for creating specific application schema in many simple cases.

9- Annotations that combine GML and KML are suggested.

10- Corrigendum for this version includes: clarification of requirements on domainSet, rangeSet and rangeType for GMLJP2CoverageCollection container, CRS definition for RectifiedGridCoverage (requirement 6) and replacement of OGC BP OGC 07-092r3, superseded by OGC 11-135, as reference in requirements 5 and 8.

Note: for NITF2.1- GMLJP2 Mapping see OGC12-154 OWS-9 OWS Innovations GMLJP2 for National Imagery Transmission Format (NITF) Engineering Report.

## **vii. Future work**

Based on this interface standard an extension to the Web Coverage Service (WCS) 2.0 is foreseen. This extension is going to specify how JPEG2000 encoded coverages can be requested from a WCS including parameters defining JPEG2000 features such as compression, tiling, etc.

It is also foreseen to adapt and expand the supporting types of the GeoReferenceable type of coverage based on adopted extensions of GML, once it is available.

The inclusion of KML2.3 (once that version of the standard is available) will be included in the annotation extension part.

Testing is needed for metadata streaming capabilities in JPIP protocol. GMLJP2 could serve as a key working example for testing out the decomposed XML feature with JPIP (for efficient streaming of metadata associated to the ROI Region of Interest). This could be part of GMLJP2 extension.

## **Foreword**

This edition cancels and replaces the original encoding standard [OGC 05-047r3] which has been technically revised.

This document refers to the OGC 12-083 document as OGC GMLJP2 extension and to OGC 12-108 GML Application Schema Coverages JPEG2000 Coverage Encoding Extension.

The short form of this OGC standard shall be referred to as GMLJP2.

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

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

## Introduction

The OGC Geography Markup Language (GML) standard is an XML grammar for the encoding of geographic information including geographic features, coverages, observations, topology, geometry, coordinate reference systems, units of measure, time, and value objects. The Coverage is loosely speaking, the digital representation of a spatio-temporally varying phenomenon; the formal definition of ISO 19123 (which is identical to OGC Abstract Topic 6) defines coverages formally as *collection of direct positions in a coordinate space that may be defined in terms of up to three spatial dimensions as well as a temporal dimension. Examples of coverages include rasters, triangulated irregular networks, point coverages and polygon coverages. Coverages are the prevailing data structures in a number of application areas, such as remote sensing, meteorology and mapping of bathymetry, elevation, soil and vegetation.* The GML Application Schema – Coverages (GMLCOV) is a GML application schema uses GML 3.2 Coverages and SWE Common generate a common application schema that can be used to describe coverage instances.

The ISO JPEG 2000 standard is a wavelet-based encoding for imagery that provides the ability to include XML data for description of the image within the JPEG 2000 data file.

The JPEG 2000 standard does not, however, describe any means for including ancillary geographic information within the image, such as the geospatial coordinates of the image or annotations or references to features.

The only available solutions that have been identified based on civil standards are:

- Use of “World files” which have some limitations for georeference information, and also need an auxiliary file
- Use of GeoJP2 (which is GeoTIFF tags inside a uuid box in JP2 format, which is a “de facto” standard with limited capabilities, whose key advantage is that it has been quickly developed, and may be quickly implemented, but would require some clarifications and additional capabilities for addressing the full scope of complex geospatial imagery. Cf. "GeoTIFF Box" specification for JPEG 2000 Metadata Avril 2004 (M. Gerlek) [http://www.lizardtech.com/download/geo/geotiff\\_box.txt](http://www.lizardtech.com/download/geo/geotiff_box.txt)
- The use of GMLJP2 version 1.0 that has a loosely specified Coverage schema, loosely specified rules for the georeference mechanism, and loosely specified conformance clause based on this loose schema.

This standard defines the means by which the GMLCOV application schema and other means are to be used within JPEG 2000 for such purposes.

This specification includes the following:

- Specification of the uses of GMLCOV and GML within JPEG 2000 data files and an extendable GML application schema. This includes georeference capability is based on GML, so inline with the OGC and TC211 standard for the encoding of Geospatial data.

- Packaging mechanisms for including GMLCOV and GML within JPEG 2000 data files, including brand field in File type box with value to signal JPX file and reader requirement box.
- Annotations, meaning associations between regions of interest and video, graphics, text, etc. and how can be expressed in several XML encoding, including but not limited to: KML, SVG, or some GML application schema. The visualization of the coverage can also make use of KML.
- ISO metadata, Earth Observation profile metadata or other profiles examples for imagery metadata inclusion

# OGC® GML in JPEG 2000 (GMLJP2) Encoding Standard

## 1. Scope

This standard applies to the encoding and decoding of JPEG 2000 images that contain GML for use with geographic imagery.

This document specifies the use of the Geography Markup Language (GML) within the XML boxes of the JPEG 2000 data format and provides an application schema for JPEG 2000 that can be extended to include geometrical feature descriptions and annotations. The document also specifies the encoding and packaging rules for GML use in JPEG 2000.

This document is applicable to those interested in using JPEG 2000 as a standardized geographic image format.

It specifies a minimally required GMLCOV definition for georeferencing images and gives guidelines for augmenting that definition to address the additional encoding of metadata, features, annotations, styles, coordinate reference systems, and units of measure. This document treats the case of packaging a single geographic image and the case of packaging multiple geographic images (multiple codestreams).

This core document only addresses rectified grid coverages.

Further extensions should address non-rectified grid coverages (Referenceable grid coverage) and image annotations which are not specified hereafter.

## 2. Compliance

Standardization targets are geospatially enabled JPEG2000 encoders and readers.

This document establishes a single requirements class, core, of <http://www.opengis.net/spec/GMLJP2/2.0/req/core> with a single pertaining conformance class, core, with URI <http://www.opengis.net/spec/GMLJP2/2.0/conf/core>. Requirements and conformance test URIs defined in this document are relative to <http://www.opengis.net/spec/GMLJP2/2.0/>

Compliance with this standard shall be checked using all the relevant tests specified in Annex A (normative).

### 3. Normative references

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

- |                |   |
|----------------|---|
| [RFC 2396]     | IETF RFC 2396, Uniform Resource Identifiers (URI): Generic Syntax (1998)  |
| [ISO 15444-1]  | ISO/IEC 15444-1:2004, JPEG 2000 image coding system: Core coding system   |
| [ISO 15444-2]  | ISO/IEC 15444-2:2004, JPEG 2000 image coding system: Extensions   |
| [ISO 15444-4]  | ISO/IEC 15444-4:2004, JPEG 2000 image coding system: Conformance testing  |
| [ISO 19105]    | ISO 19105:2000, Geographic information – Conformance and Testing  |
| [ISO N2887]    | ISO/IEC JTC 1/SC 29/WG1 N2887 (Klaus Jung), Including GML data based on the OpenGIS standard in JPEG 2000 family files (March 2003) <a href="http://www.jpeg.org/public/wg1n2887.doc">http://www.jpeg.org/public/wg1n2887.doc</a> |
| OGC [07-036]   | OGC 07-036, Geography Markup Language V3.2.1 (July 2007)  |
| OGC [06-121r3] | OGC 06-121r3, OWS Web Services Common Specification (February 2007)   |
| OGC [09-046r2] | OGC 09-046r2 OGC Naming Authority – Procedures  |
| OGC [11-135]   | OGC 11-135 Name Type Specification for Coordinate Reference Systems   |
| OGC [10-157r2] | OGC 10-157r2, Earth Observation Metadata profile of Observation & Measurements (May 2011)   |
| OGC [09-146r2] | OGC 09-146r2 1.0.1, GML Application schema -Coverages (February 2012)   |
| OGC [12-108]   | OGC 12-108, GML application schema - JPEG2000 Coverage Encoding Extension   |

In addition to this document, this standard includes several normative XML Schema Document files as specified in the Annexes.

### 4. Terms and definitions

In addition to the following, this document uses the standard terms and definitions given in Clause 4 of [OGC 06-121r3].

#### 4.1 annotation

marking on illustrative material for the purpose of clarification [ISO19117]

Note For example, this can be an association between an annotation entity (e.g. a text label) and an image or some geometric “region” within the image. [OGC 05-047r3]

#### 4.2 codestream [ISO/IEC 15444-1]

A collection of one or more bit streams and the main header, tile-part headers, and the EOC required for their decoding and expansion into image data. This is the image data in a compressed form with all of the signalling needed to decode. .

Note: This is the image data in a compressed form with all of the signaling needed to decode

#### 4.3 coordinate

one of a sequence of n numbers designating the position of a **point** in n-dimensional space [ISO 19111]

Note: In a coordinate reference system, the coordinate numbers are qualified by units.

#### 4.4 coordinate reference system

coordinate system that is related to an object by a datum [ISO 19111]

Note: For geodetic and vertical datums, the object will be the Earth.

#### 4.5 coordinate system

set of mathematical rules for specifying how **coordinates** are to be assigned to **points** [ISO 19111]

#### 4.6 coverage

**feature** that acts as a **function** to return values from its **range** for any direct position within its spatiotemporal **domain** [ISO 19123]

Note: A coverage is a representation of continuous geographic phenomena, which vary over space and have no specific extent (e.g. imagery or elevation data). A coverage associates a position within its domain to a record of values of defined data types. (from ISO 19123)

#### 4.7 curve

1-dimensional geometric-primitive, representing the continuous image of a line [ISO 19107]

#### 4.8 datum

parameter or set of parameters that define the position of the origin, the scale, and the orientation of a coordinate system [ISO 19111]

Note: A datum may be a geodetic datum, a vertical datum, an engineering datum, an image datum, or a temporal datum.

#### 4.9 domain

well-defined **set** [ISO/TS 19103]



Note 1: A mathematical **function** may be defined on this set, i.e. in a function  $f:A\rightarrow B$   $A$  is the domain of function  $f$ .

Note 2: A domain as in domain of discourse refers to a subject or area of interest.

#### 4.10 feature

abstraction of real world phenomena [ISO 19101]

Note: A feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant. A coverage is a type of feature, but ‘feature’ data generally refers to geometric primitives (points, lines, surfaces, solids) that represent discrete real world phenomena (i.e. objects with well-defined boundaries).

#### 4.11 function

rule that associates each element from a domain (source, or **domain** of the function) to a unique element in another domain (target, co-domain, or **range**) [ISO 19107]

#### 4.12 grid

network composed of two or more sets of **curves** in which the members of each set intersect the members of the other sets in an algorithmic way [ISO 19123]

Note: The curves partition a space into grid cells

#### 4.13 map

pictorial representation of geographic data

#### 4.14 object

entity with a well-defined boundary and identity that encapsulates state and behavior [ISO 19107]

Note: A GML object is an XML element of a type derived from AbstractGMLType.

#### 4.15 point

0-dimensional geometric primitive, representing a position [ISO 19107]

Note: The boundary of a point is the empty set.

#### 4.16 range

set of all values a **function**  $f$  can take as its arguments vary over its **domain**

#### 4.17 rectified grid

**grid** for which there is an affine transformation between the grid coordinates and the **coordinates** of an external **coordinate reference system** [ISO 19123]

#### 4.18 set

unordered collection of related items (**objects** or values) with no repetition [ISO 19107]

## 5. Conventions

### 5.1 Abbreviated terms

GML	Geography Markup Language
IETF	Internet Engineering Task Force
JP2	JPEG 2000 File format, cf. 15444 Part I Annex I
JPEG	Joint Photographic Experts Group
JPX	JPEG 2000 Extended File format, cf. 15444 Part II Annex M
RFC	Request for Comments
URI	Uniform Resource Identifier
XML	Extensible Markup Language

### 5.2 Namespace prefix conventions

The namespace abbreviated 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.

**Table 1 — Namespace mappings**

Prefix	Namespace URI	Description
gml	<a href="http://www.opengis.net/gml/3.2">http://www.opengis.net/gml/3.2</a>	GML 3.2
swe	<a href="http://www.opengis.net/swe/2.0">http://www.opengis.net/swe/2.0</a>	SWE Common 2.0
gmlcov	<a href="http://www.opengis.net/gmlcov/1.0">http://www.opengis.net/gmlcov/1.0</a>	GML Application Schema for Coverages 1.0
gmljp2	<a href="http://www.opengis.net/gmljp2/2.0">http://www.opengis.net/gmljp2/2.0</a>	GML JP2 application schema version 2.0

## 6. Roles of GML in JPEG 2000 for geographic imagery

### 6.1 Introduction

This clause describes the roles of GMLCOV and GML in JPEG 2000 for geographic imagery. The description of these roles provides the context for the supporting mechanisms described in Clause 7. When encoding information according to one of the types described in this clause the corresponding encoding mechanism specified in Clause 7 should be used.

The role of GMLCOV in relation to JPEG 2000 is to provide an XML encoding of the coverage metadata necessary to make the JPEG 2000 document a georeferenced or geographic image or georeferenceable image. This is accomplished by providing, using the GMLCOV application schema, the description of the image geometry and radiometry. In addition, GML data can be used, as described in this clause, for the encoding of geographic features, annotations, annotation and feature styling, and supporting components for coordinate reference systems and unit of measure definitions.

The GMLCOV and GML data are stored within the JPEG 2000 file using the XML Box mechanisms provided by the JPEG 2000 standard and the encodings described in Clause 8.

### 6.2 Use-cases

GMLJP2 is intended to handle a variety of imaging use cases including the following:

1. Georeferencing of a single image, in which a coverage collection is used to encapsulate GMLCOV elements to describe the geometry and the radiometry of the data. Examples include JPEG 2000 encoding of simple imagery, or JPEG 2000 responses to WMS or WCS requests.
2. Same as 1, but for multiple images of the same type. A coverage collection is used to encapsulate GMLCOV elements to describe the geometry and the radiometry of the constituent images. Examples include a single JPEG 2000 file that contains stereo photographic pair data, a triangulation block of images, or a collection of image tiles making up an image mosaic.
3. Same as 2, but for images of different types. A coverage collection is used to encapsulate GMLCOV elements to describe the geometry and the radiometry of the constituent images. Examples include a single JPEG 2000 file that contains a combination of images relating to the identification of a target and its environs, such an optical image, a FLIR dataset, and one or more SAR images.
4. Rectified images with or without associated digital elevation models. GMLCOV can be used to provide the geometry and, optionally, elevation information.
5. Images that correspond to elevation grid and associated metadata
6. Images that require annotations, such as for explanatory text or simple vector graphics to communicate additional information about what the image is portraying.
7. Images that are required to be accompanied by arbitrary feature data. The GML can be used to describe the features. An example of this would be a single

- GMLJP2 file in substitution to the use of a pair of files such as a GeoTIFF and a Shapefile.
8. Same as 1, but with additional coverage provided to indicate the semantic meaning of specific pixel (sample) values, e.g. for “no-data” or high-saturation indicators.
  9. Images that require an associated sensor model for analysis and geopositioning. SensorML describes all processes and components in GML.
  10. Images that require associated access rights. GeoXACML is a general purpose language to declare and enforce access control rights, e.g. a condition where the user can access all features inside or outside a particular geographical area.
  11. Multiple codestream encoding enables multiple images of the same or different type (different geometry, different radiometry) to be packaged in a single JPEG 2000 file. Multiple ASOC boxes within the “outer” association box labeled gml.data may refer to the different codestreams, e.g., pressure, ozone as separate codestreams with associated schemas.
  12. Images coming out from radar sensors (after SLC)
  13. Large mosaic dataset tested (>10GB up to 40 GB in one single GMLJP2 file).

## 7. JPEG2000 Coverage description requirements (core)

Section 7 and 8 describe the use of the GMLCOV to describe both a coverage collection and the individual coverages for its usage in a JPEG2000 encoding format. A Coverage collection is needed because a GMLJP2 file (dataset) may contain:

A single codestream (raster) associated with a single coverage with a XML encoding of the metadata necessary to make the JPEG2000 document a georeferenced or geographic image (Minimum Use Case).

A sequence (collection) of codestreams with a sequence of corresponding coverages

A single codestream associated with a single coverage, and associated features and annotations, together with styling information.

A sequence (collection) of codestreams with a sequence of corresponding coverages, each coverage being associated with its features and annotations, together with styling information.

Geographic metadata may be associated to the coverage collection (the whole GMLJP2 file). This metadata is at the “aggregate” level, aggregate here being any structure of elements corresponding to cases 2 to 4.

The result is a GML document providing the information of the coverage(s) and associated features, annotations and styling (if any).

Section 7 describes some particularities in the use of GMLCOV to encode different aspects of the data and Section 8 describes the complete structure of a GMLJP2 XML encoding.

Requirements class *gmljp2* establishes how a coverages representation, metadata, GML features and annotations can be embedded in the JPEG2000 encoding format. Its identifying URL is given by <http://www.opengis.net/spec/gmljp2/2.0/req>.

This standard rely on OGC 09-146r2, GML Application Schema – Coverages Encoding Specification version 1.0.1. (May 2012) and OGC 12-108, GML Application Schema - Coverages - JPEG2000 Coverage Encoding Extension for what concern:

- *gmljp2:GMLJP2GridCoverage*,
- *gmljp2:GMLJP2RectifiedGridCoverage*,
- *gmljp2:GMLJP2ReferenceableGridCoverage*

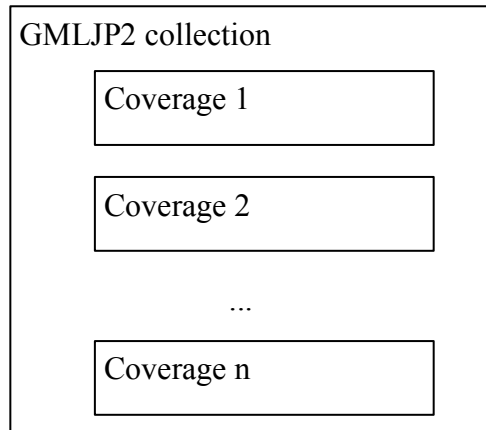
Informative:

The *ReferenceableGridCoverage* is also handled by the GMLCOV specification but because the usage of GML 3.3 it will be specified in the GMLJP2 extensions.

### **Requirement 1 /req/gmljp2-gmlcov**

**A JPEG2000 encoded file conformance to this standard shall use a GMLCOV coverage description following the OGC12-108 GML Application Schema - Coverages - GMLJP2 Coverage Encoding Extension to describe the coverage collection and to describe the individual coverages.**

**Dependency:** [http://www.opengis.net/spec/gmlcov\\_jpeg2000/coverages/1.0/req/jpeg2000-coverage](http://www.opengis.net/spec/gmlcov_jpeg2000/coverages/1.0/req/jpeg2000-coverage)



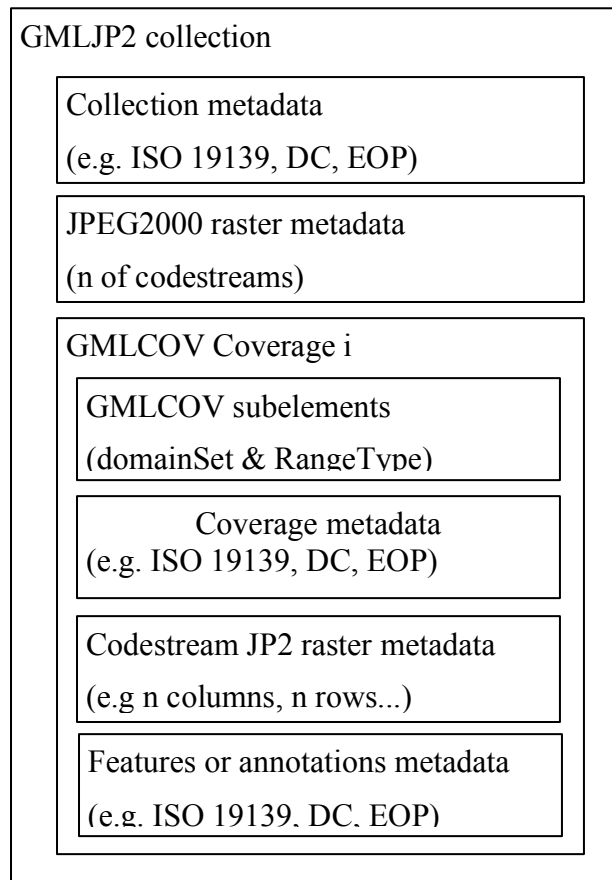
**Figure 1 — GMLJP2 usage as a coverage collection with individual coverages**

### 7.1 Coverage metadata

This clause describes the use of GMLCOV to encode data about such geographic images. This approach considers three different types of such “metadata”:

1. “Traditional” metadata, e.g. ISO 19139 [2], in Earth Observation profile, etc
2. GMLCOV information, from the GML Coverage
3. Image information, from the JPEG 2000 image header

Some metadata can be at the coverage collection level and some other at the coverage level. Some metadata origins can be redundant and the requirements provided here specify precedence.



**Figure 2 — Metadata origins, root JP2/JPX header metadata are outside the GML document**

At the coverage collection level, the JPEG 2000 header metadata provides information about the number of codestreams. At the individual coverage level, JPEG 2000 header metadata provides information about the number of rows and columns, the number of resolution levels and eventually an internal tiling schema. GMLCov provides a metadata property, `gmlcov:metadata` which can be attached to any GMLCov object and will be used to encode metadata about the coverage. The GML metadata property, `gml:metaDataProperty`, can be attached to any GML object and it is only intended for metadata about extra elements that the GMLJP2 encodes such as GML features or annotations.

Both `gmlcov:metadata` and `gml:metaDataProperty` can either point (via `xlink:href`) to a metadata property package expressed via a GML metadata application schema, or enclose a bundle of such metadata properties in-line. This can be an ISO19139 document, an EOP XML description or a custom supported, user-defined metadata schema. Some elements can be redundant in more than one description. It is the responsibility of the data provider to avoid redundant information, and if coverage metadata provides redundant information the data provider is responsible to ensure that it is consistent with the coverage descriptions provided in GMLCOV or the JPEG2000 headers.

**Requirement 2 /req/header-precedence:** In a JPEG2000 encoded file containing coverage metadata about the internal structure of the JPEG2000 file (e.g. number of codestreams, number of rows and columns of a codestream) shall be coherent with the JPEG2000 binary header information. In case of discrepancies the JPEG2000 binary headers information takes precedence.

**Requirement 3 /req/gmlcov-precedence:** In a JPEG2000 encoded file including gmlcov:metadata with information redundant with the GMLCOV information in gml:domainSet or gmlcov:rangeType (e.g. geometric or radiometric information in ISO19139 format), both shall be coherent. In case of discrepancies the gml:domainSet or gmlcov:rangeType information takes precedence.

**Requirement 4 /req/gml-metaDataProperty:** In a JPEG2000 encoded file the gml:metaDataProperty shall neither encode metadata about the coverage collection nor the individual coverages.

Note: gmlcov:metadata gml:metaDataProperty is intended for metadata about extra GML features, annotations etc.

It is possible to include metadata in the coverage information in several formats. One possibility is to use ebRIM:RegistryObject as the first class element. Another is to include an ISO19139 metadata description in XML. Table 2 summarizes the different alternatives that are directly possible using the XML schema provided (see annex D for examples).

**Table 2 — Choices of the gmljp2:GenericMetadata data structure**

Name	Definition	Data type and value	Multiplicity and use
isoMetadata	Metadata following ISO 19139 schema	gmd:MD_Metadata_PropertyType	Zero or one (optional)
Earth Observation Profile Metadata eopMetadata	Metadata following one of the Earth Observation profiles for Observations and measurements	eop:EarthObservationType	Zero or more (optional)
Dublin Core Metadata dcMetadata	A sequence of metadata fields following Dublin Core schema	dc:DC-elementType	Zero or more (optional)



Name	Definition	Data type and value	Multiplicity and use
Extension metadata	Metadata in any other schema	text or gmljp2:GenericPropertyWithAssocType that internally allows to any type	Zero or more (optional)

The following instance illustrates how to do it for the ISO19115/19139

```

<?xml version="1.0" encoding="UTF-8"?>
<gmljp2:GMLJP2CoverageCollection gml:id="JPEG2000_0">
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="CodeStream0">
      ...
      <gmlcov:metadata>
        <gmljp2:Metadata>
          <gmljp2:isoMetadata>
            <gmd:MD_Metadata>
              <gmd:fileIdentifier/>
              <gmd:characterSet/>
              <gmd:parentIdentifier/>
              <gmd:hierarchyLevelName/>
              <gmd:contact/>
              <gmd:dateStamp/>
              <gmd:identificationInfo>
                <gmd:MD_DataIdentification>
                  <gmd:citation>
                    <gmd:CI_Citation>
                      <gmd:title/>
                      <gmd:alternateTitle/>
                      <gmd:date/>
                    </gmd:CI_Citation>
                  </gmd:citation>
                  <gmd:abstract/>
                  <gmd:resourceFormat/>
                  <gmd:language/>
                  <gmd:extent>
                    <gmd:EX_Extent/>
                  </gmd:extent>
                </gmd:MD_DataIdentification>
              </gmd:identificationInfo>
            </gmd:MD_Metadata>
          </gmljp2:isoMetadata>
        </gmljp2:Metadata>
      </gmlcov:metadata>
    </gmljp2:GMLJP2RectifiedGridCoverage>
  </gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

Earth Observation data products are generally managed within logical collections that are usually structured to contain data items derived from sensors onboard a satellite or series of satellites. The key characteristics differentiating products within the collections are date of acquisition, location as well as characteristics depending on the type of sensor.

For example, key characteristics for optical imagery are the possible presence of cloud, haze, smokes or other atmospheric or on ground phenomena obscuring the image.

The common metadata used to distinguish Earth Observation (EO) products types are presented in this document for generic and thematic EO products (i.e. optical, radar, atmospheric, altimetry, limb-looking and synthesis and systematic products). This can be done with the Earth Observation profile metadata.

An example on how to do it is in Annex D.2

Annex D provides more examples of how metadata (including ISO19115 and Earth Observation Profile) can be embedded in a XML file.

### **7.2 Image annotation**

An image annotation can be defined as an association between an annotation entity (e.g. a text label) and an image or some geometric “region” within the image. Annotations can be provided in image coordinates (pixels), or in a CRS coordinates defined by the GMLCOV reference part (e.g. GML).or in a common CRS in case it would be different from the CRS defined by the CMLCOV coverage. Annotations provide an association between geometric “regions” (0-d, 1-d, 2-d, etc.) in an image and annotation text, imagery, video and feature references. Annotations are deeply linked to styles for visual presentation. An annotation can be thought of as drawing attention to some “region” of an image.

See section 11 for a more complete reference to annotation approaches

### **7.3 Geographic features**

Geographic features, e.g. features obtained from an image by image interpretation, can be packaged inside the JPEG 2000 image. Such features may be directly associated with a particular image in the JPEG 2000 file or may be independent of the image altogether.

Geographic features included in a JPEG2000 encoded image using GMLJP2 will be encoded as GML features 3.2 and comply with the rules for GML application schemas as defined in Clause 21 of the OGC 07-036 GML 3.2.1 standard. Encoding of features requires an associated GML application schema.

### **7.4 Feature styling**

Geographic features in GML express geographic content. Visual presentation of such geographic features requires a styling mechanism to interpret and transform the GML features into graphical objects (e.g. SVG or KML).

For example, styling rules can be expressed using the following approaches:

- OGC Styled Layer Descriptors / Symbology Encoding
- GML default styling
- KML fragments

### **7.5 Coordinate reference systems**

Coverage geometries, the geometric properties of GML features and annotations include coordinates which are interpreted within the context of a coordinate reference system

(CRS). According to the rules of GML, the coordinate reference system is specified via URI. This URI may identify the CRS by reference to an authority and an authority maintained code. Alternatively, these URI may identify the physical location of a CRS definition.

References to Coordinate Reference Systems (CRS) may take one of the following forms:

- Reference to an authority and authority maintained code OGC 11-135 and in <http://www.opengis.net/def>. (Some of them are also defined in <http://schemas.opengis.net/definitions/1.1.0/>)
- Reference to CRS definition

**Requirement 5 /req/gmlcov-CRS-byref:** In those cases where a CRS is identified by reference to an authority and code, it SHALL be identified by URI following the OGC document OGC 11-135 and maintained in <http://www.opengis.net/def> (URIs of Definitions in OGC Namespace).

In those cases where an actual CRS definition is required, GML provides a grammar for encoding such coordinate reference systems. The coordinate reference system definitions encoded in GML can then be packaged with the JPEG 2000 data (as for features etc.) and referenced from the coverage description or features or can exist externally. This enables both network-centric and standalone implementations of GML and JPEG 2000 to be deployed.

Some coordinate reference systems may require use of a GML coordinate reference system application schema. Mechanisms for referencing and/or transporting GML application schemas are discussed in Clause 9. There is no default CRS, but only one CRS for each RectifiedGridCoverage, which is carried by the `gml:RectifiedGrid` element (in `srsName`) in the `domainSet`. Other sub-elements may also duplicate this `srsName` definition.

**Requirement 6 /req/gmlcov-RectifiedGridCoverage-CRS:** The RectifiedGridCoverage model of GMLCOV requires the definition of the CRS associated to each coverage; this is done by the `srsName` attribute of the `gml:RectifiedGrid` element in the `domainSet`.

Note: GMLJP2 follows the definition of grids in GML 3.2.1 [OGC 07-036] clause 19.2.2: “When a grid point is used to represent a sample space (e.g. image pixel), the grid point represents the center of the sample space (see ISO 19123:2005, 8.2.2)”. This corresponds with the `pixelInCell` value of `ImageCRS` set to `CellCenter` as specified in ISO 19111. This can be interpreted as the origin of the `RectifiedGrid` is the centre point of the corner pixel.

## 7.6 Units of measure

Coverage values, properties of GML features and annotations may employ references to units of measure (UoM). According to the rules of GML references to Units of Measure may take one of the following forms:

Reference to an authority and authority maintained code OGC 11-135 and in <http://www.opengis.net/def>. (Some of them are also defined in <http://schemas.opengis.net/definitions/1.1.0/>)

### 7.7 Reference to UOM definition

Coverage value units are defined in `gmlcov:rangeType/swe:DataRecord/swe:uom`.

**Requirement 7 /req/gmlcov-rangetype-uom:** In a JPEG2000 encoded file with coverage values with units of measure, the element tag must occur in the GMLCOV (`gmlcov:rangeType/swe:DataRecord/swe:uom`).

**Requirement 8 /req/gmlcov-uom-byref:** In those cases where a UoM is identified by reference to an authority and code, it SHALL be identified by URI following the OGC document OGC 11-135 and maintained in <http://www.opengis.net/def> (URIs of Definitions in OGC Namespace).

Recommendation: The use of inapplicable “unity” unit of measure is recommended (instead of unknown) for values without unit of measure (e.g. for image Panchro or RGB pixels):

```
<swe:uom code="unity"/>      <!-- Unity for value without unit of measures -->
```

Informatively, the definitions of some units of measure and the equivalent URIs are listed in Table 3. Many units can be also specified using EPSG URIs.

**Table 3 — URIs for units-of-measure**

OGC URI	Meaning	Quantity type	EPSG URI
<a href="http://www.opengis.net/def/uom/OGC/1.0/degree">http://www.opengis.net/def/uom/OGC/1.0/degree</a>	Angular degree	angle	<a href="http://www.opengis.net/def/uom/EPSSG/6.3/9102">http://www.opengis.net/def/uom/EPSSG/6.3/9102</a>
<a href="http://www.opengis.net/def/uom/OGC/1.0/radian">http://www.opengis.net/def/uom/OGC/1.0/radian</a>	Angular radian	angle	
<a href="http://www.opengis.net/def/uom/OGC/1.0/metre">http://www.opengis.net/def/uom/OGC/1.0/metre</a>	Length metre	length	<a href="http://www.opengis.net/def/uom/EPSSG/6.3/9001">http://www.opengis.net/def/uom/EPSSG/6.3/9001</a>

Units of Measure definitions may be optionally included as dictionary entries in an XML box (see Clause 8.) within the JPEG 2000 file. In those cases where an actual UOM definition is required, GML provides a grammar for the encoding of such units of measure. The units of measure definitions encoded in GML can then be packaged with the JPEG 2000 data (as for features etc.) and referenced from the coverage description or features or can exist externally. This enables both network-centric and standalone implementations of GML and JPEG 2000 to be deployed. Mechanisms for referencing and/or transporting GML application schemas are discussed in Clause 10.

### 7.8 Nil values

It is often useful to be able to specify the semantic intent for sample values in the imagery, such as for “nodata” pixels or samples (nil values) whose values that were invalid, or not acquired or were clipped due to high or low saturation. Possible reasons for NIL values can be seen in table 4 and some of them are defined in OGC 07-036 section 8.2.3.1.

**Requirement 9 /req/gmlcov-nil-values:** In a JPEG2000 encoded file with nil-values, the element tag shall occur in the GMLCOV (gmlcov:rangeType/swe:DataRecord/swe:field/swe:Quantity/swe:nilValues) with an appropriate swe:nilValue/@reason to give the client an indication on how to represent them.

**Requirement 10 /req/gmlcov-nil-reason-byref:** In those cases where the reason is identified by reference to an authority and code, it SHALL be identified by URI following the OGC document [09-046r2] and maintained in <http://www.opengis.net/def> (URIs of Definitions in OGC Namespace).

It is the client’s job to interpret such special values; this standard does not require that a client be able to interpret those values. Informatively, the definitions of some reasons and the equivalent URIs are listed in Table 4.

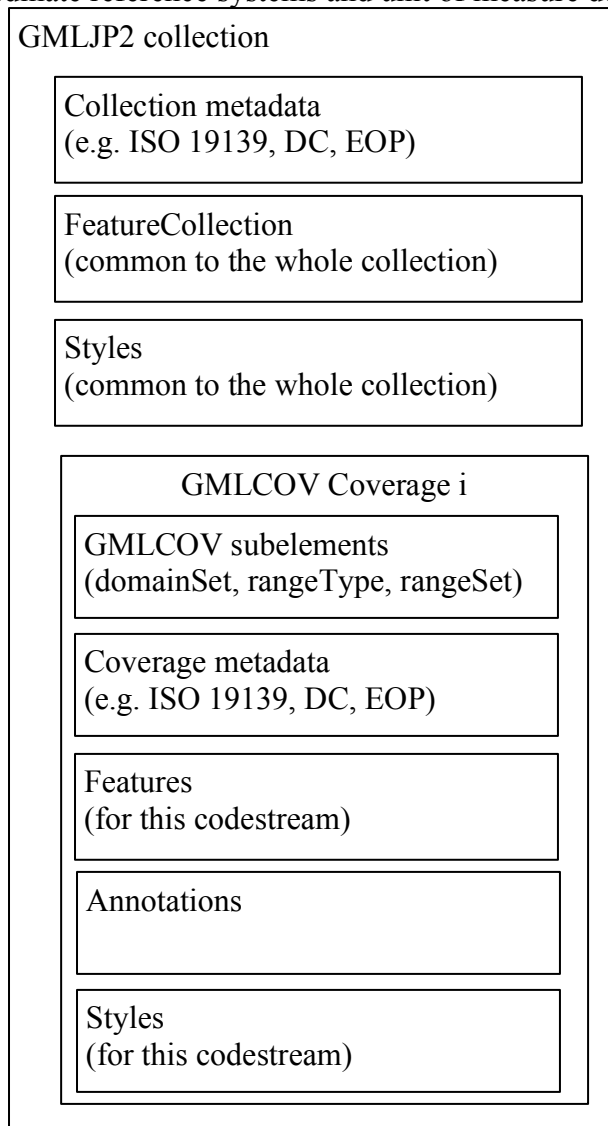
**Table 4 — NIL reasons**

OGC URI	Meaning	How to represent it
<a href="http://www.opengis.net/def/nil/OGC/0/AboveDetectionRange">http://www.opengis.net/def/nil/OGC/0/AboveDetectionRange</a>	Above detection range	We recommend that the client typically show the pixel as white
<a href="http://www.opengis.net/def/nil/OGC/0/BelowDetectionRange">http://www.opengis.net/def/nil/OGC/0/BelowDetectionRange</a>	Below detection range	We recommend that the client typically show the pixel as black.
<a href="http://www.opengis.net/def/nil/OGC/0/inapplicable">http://www.opengis.net/def/nil/OGC/0/inapplicable</a>	No value available	We recommend rendering in a way that any underlying data should show through, i.e. according to “transparency” rules. If no data is “underneath”, the client should render the default background color.
<a href="http://www.opengis.net/def/nil/OGC/0/missing">http://www.opengis.net/def/nil/OGC/0/missing</a>	The correct value is not readily available to the sender of this data. Furthermore, a correct value may not exist	We recommend rendering in a way that any underlying data should show through, i.e. according to “transparency” rules. If no data is “underneath”, the client should render the default background color.
<a href="http://www.opengis.net/def/nil/OGC/0/template">http://www.opengis.net/def/nil/OGC/0/template</a>	The value will be available later	We recommend rendering in a way that any underlying data should show through, i.e. according to “transparency” rules. If no data is “underneath”, the client should render the default background color.
<a href="http://www.opengis.net/def/nil/OGC/0/unknown">http://www.opengis.net/def/nil/OGC/0/unknown</a>	The correct value is not known to, and not computable by, the sender of this data. However, a correct value probably exists	We recommend rendering in a way that any underlying data should show through, i.e. according to “transparency” rules. If no data is “underneath”, the client should render the default background color.
<a href="http://www.opengis.net/def/nil/OGC/0/withheld">http://www.opengis.net/def/nil/OGC/0/withheld</a>	The value is not divulged	We recommend that the client show the pixel as black or grey or similar color, so as to indicate that this portion of the image has been masked out on purpose, e.g. for security reasons.

## 8. Encoding rules for GML in JPEG 2000 (core)

### 8.1 Introduction

This section specifies the requirements that shall be followed when encoding XML data for use within JPEG 2000 files. The primary role of GML in relation to JPEG 2000 is to make the latter into a geographic image. This is accomplished by providing GMLCOV description of the image geometry (DomainSet) and radiometry (RangeType). In addition, GML data can be used, as described in this clause, for the encoding of metadata, geographic features, annotations, annotation and feature styling, and supporting components for coordinate reference systems and unit of measure definitions.



**Figure 3 — GMLJP2 collections and individual coverages subelement possibilities**

**Requirement 11 /req/gmlcov-coverage-collection-container**

A GMLJP2 XML description of an image shall have a `gmljp2:GMLJP2CoverageCollection` as single root element derived from `gmlcov:AbstractCoverageType` that is a container for other elements. The sub-elements `gml:domainSet`, the `gml:rangeSet` and the `gmlcov:rangeType` (which are inherited from the GMLCOV schema) shall be populated with `nilReason` “inapplicable” value, and indicate that the `GMLJP2CoverageCollection` is a Collection as indicated below ; the `boundedBy` element may provide the bounding box for the collection.

**Dependency:** /req/gmlcov

```
<gml:domainSet nilReason="inapplicable"/>
<gml:rangeSet>
  <gml:DataBlock>
    <gml:rangeParameters nilReason="inapplicable"/>
    <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTupleList>
  </gml:DataBlock>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Collection"> </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
```

Child elements of `GMLJP2CoverageCollection` are described in the following section and in Tables 5 to 6. The structure of the GMLJP2 document is represented as a UML diagram in the Annex B.

**Requirement 12 /req/gmlcov-coverage-container**

For each codestream present in the image single child `gmljp2:featureMember` derived from `gmlcov:AbstractCoverageType` (i.e. `gmljp2:GMLJP2GridCoverage`, `gmljp2:GMLJP2RectifiedGridCoverage` or `gmljp2:GMLJP2ReferenceableGridCoverage`) (composed by a description of the `gml:domainSet`, the `gml:rangeSet` and the `gmlcov:rangeType`) shall be provided and populated.

**Dependency:** /req/gmlcov

**Requirement 13 /req/gmlcov- metadata**

If needed, coverage metadata descriptions (e.g. ISO19115 or EOP) shall be included in the subelement `gmlcov:metadata` which can be attached to the `gmljp2:featureMember` derived from `gmlcov:AbstractCoverageType`.

**Requirement 14 /req/gml-feature-container**

When there are features related to the JPEG 2000 file that should be included (except the GMLCOV part and annotations if any), these features shall be encoded in GML 3.2



and shall be included in either in a child featureElement containing gmljp2:GMLJP2Features (for features common to all codestreams) or from a gmljp2:feature element of the GMLJP2 elements derived from gmljp2:GMLJP2CoverageType (for features that are related to a single codestream).

**Note:** It is strongly recommended to use the GML xlink.href mechanism to link to big GML document instead of embedding the data inline.

Future extensions of this standard may define concrete GML application schemas to describe features for specific applications.

**Requirement 15 /req/annotation-container**

When there are annotations related the JPEG 2000 file that should be included, these annotations shall be child elements of the gmljp2:annotation element of the of the GMLJP2 elements derived from gmljp2:GMLJP2CoverageType.

Future extensions of this standard may define specific encoding for transporting annotations for specific applications. See section 11

**Requirement 16 /req/style-container**

When styling information of the features or annotations related the JPEG 2000 file should be included independent from the features, these styles shall be included in a gmljp2:style element of the coverage collection or the individual coverages.

**For example,** the gmljp2:style element can include an SLD as a style layer description that describes styles of the gmljp2:feature element.

Extensions of this standard can define other sections in the gmljp2:GMLJP2CoverageType in the future.

A specific schema defining the gmljp2 is provided in this standard that includes GMLCOV 1.0, GML 3.2, ISO metadata, DC metadata and EOP metadata. The GMLCOV description is the first part of the XML document.

All child elements in the gmljp2:GMLJP2CoverageType are derived from gml:AssociationAttributeGroup and can be described in-line or by referencing other elements of the same XML or from different XML using xlink.href.

**Table 5 — Parts of the gmljp2:GMLJP2 CoverageCollection data structure**

Name	Definition	Data type and value	Multiplicity and use
Extent gml:bounded By	Informative extent of the JPEG image.	gml:BoundingShapeType	Zero or more (optional)
Metadata gmlcov:metadata	Metadata about the coverage collection	gmljp2:GenericMetadataType (see Table 2)	Zero or more (optional)
Coverage gmlcov:featureMember	Individual coverage description	gmljp2:GMLJP2CoverageType (see Table 6)	One or more (mandatory)

Features gmlcov:featureMember	GML features associated with the whole coverage collection that are neither individual coverage description nor annotations	gmljp2:GMLJP2FeaturesType	Zero or more (optional)
Style style	Common styles applicable to all features.	gmljp2:GenericPropertyWithAssocType that internally allows to any type	Zero or more (optional)
extension	Any other element	gmljp2:GenericPropertyWithAssocType that internally allows to any type	Zero or more (optional)

**Table 6 — Parts of the Coverage data structure**

Name	Definition	Data type and value	Multiplicity and use
Extent gml:boundedBy	Informative extent of the individual coverage.	gml:BoundingShapeType	Zero or more (optional)
DomainSet gml:domainSet	Description of spatio-temporal region of interest.	gml:DomainSetType	One or more (mandatory)
RangeSet gml:rangeSet	Contains a reference to the values of the coverage	gml:RangeSetType	One or more (mandatory)
DataRecord gmlcov:rangeType	Describes the structure of a coverage's range values	swe:DataRecordPropertyType	One or more (mandatory)
Metadata gmlcov:metadata	Metadata about the coverage	gmljp2:GenericMetadataType (see Table 2)	Zero or more (optional)
Feature feature	GML features associated with this coverage that are neither the coverage description nor annotations	gml:FeaturePropertyType	Zero or more (optional)
Annotation annotation	Annotations over this coverage.	gmljp2:GenericPropertyWithAssocType that internally allows to any type	Zero or more (optional)
Style style	Styles applicable to features.	gmljp2:GenericPropertyWithAssocType that internally allows to any type	Zero or more (optional)
extension	Any other element	gmljp2:GenericPropertyWithAssocType that internally allows to any type	Zero or more (optional)

The following example shows the GMLJP2CoverageCollection root element that this standard introduces as a way to include the mandatory coverage subelement (using GMLCOV; in this case a GMLJP2RectifiedGridCoverage is used) which also allows for metadata (where we can include or reference a metadata element or a complete metadata description), and an optional features (where we can include or reference a feature collection).

```
<gmljp2:GMLJP2CoverageCollection gml:id="JPEG2000_0"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0 gmlJP2.xsd"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
```

```

xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0"
xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>

    <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="ID_1">
      <gml:boundedBy>
        <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSSG/0/4326"
axisLabels="Lat Long" uomLabels="deg deg" srsDimension="2">
          <gml:lowerCorner>9.9 9.9</gml:lowerCorner>
          <gml:upperCorner>14.9 12.9</gml:upperCorner>
        </gml:Envelope>
      </gml:boundedBy>
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="rg0001_c0002" dimension="2"
          srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>1 1</gml:low>
              <gml:high>3 10</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisLabels>Lat Long</gml:axisLabels>
          <gml:origin>
            <gml:Point gml:id="P0001">
              <gml:pos>9.9 9.9</gml:pos>
            </gml:Point>
          </gml:origin>
          <gml:offsetVector>0 3.71e-005</gml:offsetVector>
          <gml:offsetVector>-3.71e-005 0</gml:offsetVector>
        </gml:RectifiedGrid>
      </gml:domainSet>
    </gml:rangeSet>
    <gml:File>
      <gml:rangeParameters/>
      <gml:fileName>gmljp2://codestream/0</gml:fileName>
      <gml:fileStructure>inapplicable</gml:fileStructure>
    </gml:File>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>

```

```

    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe>DataRecord>
</gmlcov:rangeType>
<gmlcov:metadata>
  <gmljp2:Metadata>
    <gmljp2:isoMetadata>
      <gmd:MD_Metadata>
        <gmd:fileIdentifier/>
        <gmd:characterSet/>
        <gmd:parentIdentifier/>
        <gmd:hierarchyLevelName/>
        <gmd:contact/>
        <gmd:dateStamp/>
        <gmd:identificationInfo>
          <gmd:MD_DataIdentification>
            <gmd:citation>
              <gmd:CI_Citation>
                <gmd:title/>
                <gmd:alternateTitle/>
                <gmd:date/>
              </gmd:CI_Citation>
            </gmd:citation>
            <gmd:abstract/>
            <gmd:resourceFormat/>
            <gmd:language/>
            <gmd:extent>
              <gmd:EX_Extent/>
            </gmd:extent>
          </gmd:MD_DataIdentification>
        </gmd:identificationInfo>
      </gmd:MD_Metadata>
    </gmljp2:isoMetadata>
  </gmljp2:Metadata>
</gmlcov:metadata>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
<gmljp2:featureMember>
  <gmljp2:GMLJP2Features gml:id="ID_FE_2">
    <gmljp2:feature>
      <gml:FeatureCollection gml:id="ID_07">
        <gml:featureMember>
          <gml:Observation gml:id="ID_08">
            <gml:validTime/>
            <gml:resultOf/>
          </gml:Observation>
        </gml:featureMember>
      </gml:FeatureCollection>
    </gmljp2:feature>
  </gmljp2:GMLJP2Features>

```

```

</gmlj2:featureMember>
</gmlj2:GMLJP2CoverageCollection>

```

## 8.2 GMLCOV for JPEG2000

GMLCOV defines the associated JPEG 2000 file as a geographic 2D coverage. Such coverage descriptions are based directly on the GMLCOV namespace `gmlcov` and do not require to define a specific application schema for each JPEG 2000 instance. There can be only ONE element of the `gmlcov:AbstractCoverageType` per codestream even though the GMLCOV element can describe more than one field (band) if the codestream also describes more than one field or band. Clause 9 provides details on the mapping of coverage description instances and codestreams in the multiple codestream case.

### Requirement 17 /req/filename-codestream

**The `fileName` subelement of the `rangeSet` in the coverage description shall contain a reference to the corresponding codestream in the JPEG2000 file. The `fileStructure` subelement shall be “inapplicable”.**

The following sketches a valid GMLCOV XML file that describes a single field (one band) embedded in a JPEG2000 XML box. Please note the use of `fileName` and `fileStructure`:

```

<gmlj2:GMLJP2CoverageCollection gml:id="CCID1"
  xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
  xmlns:gmlj2="http://www.opengis.net/gmlj2/2.0" xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/gmlj2/2.0
  http://schemas.opengis.net/gmlj2/2.0/gmlj2.xsd">
  <!-- Note: The Coverage container defines a collection grid limited to a single point whose value
  is set to 0; its domainSet is defined by a .Grid restricted to a single point whose value is 0 (in
  order to fulfil Requirement 11), whose rangeType field name is "Collection" -->
  <gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>

      <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
      leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmlj2:featureMember>
    <gmlj2:GMLJP2RectifiedGridCoverage gml:id="RGC01_CCID1">
      <gml:boundedBy>
        <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSSG/0/4326"
          axisLabels="Lat Long" uomLabels="deg deg" srsDimension="2">
          <gml:lowerCorner>1.0 1.0</gml:lowerCorner>
          <gml:upperCorner>3.0 10.0</gml:upperCorner>
        </gml:Envelope>

```

```

</gml:boundedBy>
<gml:domainSet>
  <gml:RectifiedGrid gml:id="RG_RGC01_CCID1" dimension="2"
srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
    <gml:limits>
      <gml:GridEnvelope>
        <gml:low>0 0</gml:low>
        <gml:high>99 29</gml:high>
      </gml:GridEnvelope>
    </gml:limits>
    <gml:axisLabels>Lat Long</gml:axisLabels>
    <gml:origin>
      <gml:Point gml:id="P0001_RGC01_CCID1">
        <!-- "Upper-left" image origin -->
        <gml:pos>2.95 1.05</gml:pos>
      </gml:Point>
    </gml:origin>
    <gml:offsetVector>0 0.1</gml:offsetVector>
    <gml:offsetVector>-0.1 0</gml:offsetVector>
  </gml:RectifiedGrid>
</gml:domainSet>
<gml:rangeSet>
  <gml:File>
    <gml:rangeParameters/>
    <gml:fileName>gmljp2://codestream/0</gml:fileName>
    <gml:fileStructure>Record Interleaved</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

## 9. Packaging GML in JPEG 2000 (core)

### 9.1 Introduction

This clause describes the mechanisms for packaging coverage information data and eventual GML application schemas inside JPEG 2000 data files. It also provides rules for encoding references between GML instances and GML application schemas, and between GML instances. Finally it provides the rules for associating coverage descriptions (see Clauses 6 and 7) and JPEG 2000 codestreams.

### 9.2 Use of JPEG 2000 boxes

The JPEG 2000 file format is defined as a contiguous set of *boxes*, where a box is defined as an abstract data structure used to hold arbitrary data. Different types of boxes are defined to contain different kinds of data: for example, the codestream and XML box types are used to contain, respectively, wavelet-encoded image data and XML data. Additionally, certain types of boxes known as *super-boxes* may contain other boxes.

This standard requires the use of three types of boxes in order to store and reference GML data in the JPEG 2000 file.

- The ASOC (Association) super-box contains at least two child boxes and is used to declare a relationship between the *first* child box and the remaining children.
- The LBL (Label) box is used to contain a short string, typically serving as an identifier.
- The XML box is used to contain XML data, e.g. GMLJP2 instances.

#### **Requirement 18 /req/xml-boxes**

**GMLJP2 instance data shall be stored in XML boxes. In order to allow references between these XML boxes, each XML box shall be associated with a label inside of an association box. This label serves as an identifier by which the XML data can be referenced.**

All GML instance, schema, and dictionary data is stored in XML boxes or will be linked to external files. An example JPEG 2000 file with an association box structure is shown in Figure 4.

#### **Requirement 19 /req/xml-box-signal**

**The presence of GMLJP2 XML data shall be signaled with the value 67 in a reader requirement box.**

For convenience, M6.2 de 15444-2 is repeated here:

- M.6.2 Expression representation

The expressions of the requirements to fully understand all aspects, and to display the file as desired are stored in the Reader Requirements box, which is a mandatory feature of a JPX file format. If the Reader Requirements box is not present, the File Type box describes the full functionality of the file.

- in Table M.13. The Reader Requirement Box is identified as Required.

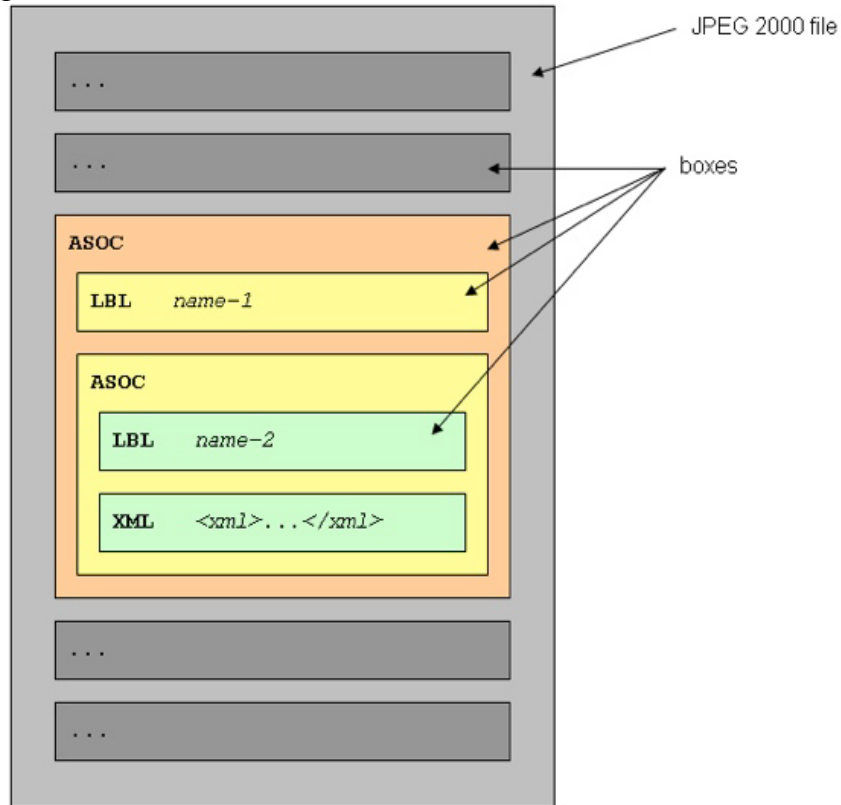
- (however) in case of absence, "If the Reader Requirements box is not present, the File Type box describes the full functionality of the file."



- use of "Brand field in File type box" : The brand field shall always be "jpx\040" for JPX files.

According to Clause 3.2 of [ISO N2887], the presence of GML data in a JPX file be signaled using the Reader Requirements box (defined in Annex M of [ISO 15444-2]) with a value of 67 (XMLGISMetaData) as the SF (standard flag) in paragraph M.11.1, meaning that the file contains GML data based on the OGC standard. The data is then packaged in XML data which is annotated with JPX labels, where the annotation works via the "association" (ASOC) box of part 2. The topmost ASOC box will contain a LBL box whose content is "gml.data", and several additional ASOC boxes of which each of them contains a LBL box giving a name to the data, and an XML box containing the actual GML payload data.

The Reader Requirements Box should respect the required fields structure as defined in the ISO 15444-2 standard. The FUAM field should be correctly set to interpret the standard flag value for the GML content.



**Figure 4 — Example JPEG 2000 file and boxes**

### 9.3 Use of JPEG 2000 Part I and Part II extensions

It is recommended to use the JPEG2000 Part I (ISO 15444-1) that is widely implemented and defines the core JPEG 2000 and that includes the syntax of the JPEG 2000 codestream.

Because the association and label boxes are defined by Part II of the JPEG 2000 standard, all GMLJP2 files SHALL implement the JPX file format as defined in [ISO 15444-2], to the extent required to support those box types.

NOTE: These two box types are the only Part II extensions used by the GMLJP2 standard.

**Requirement 20 /req/jp2-compatible**

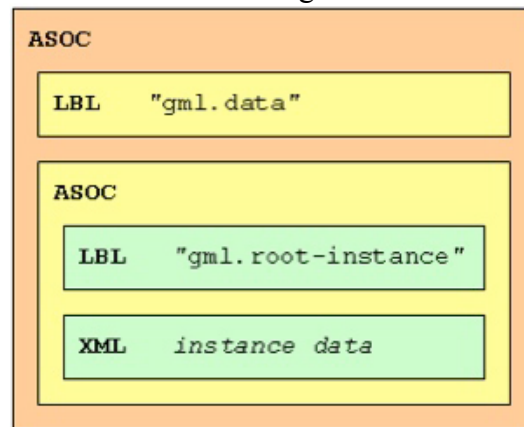
Even if GMLJP2 will use JPEG2000 part II, GMLJP2 files shall be written as JP2 compatible by including the string “jp2” within the compatibility list of the File Type box (see Annex I of [ISO 15444-1]).

**Requirement 21 /req/jp2-outer-box**

The single “outer” association box contains a first box which is a label box. This shall contain the label `gml.data`. The outer association box shall contain at least one additional association box containing GML instance data. This association box shall have a first box that is a label box with the label `gml.root-instance` and an XML box. This XML box shall only contain GML instance data for the following items and shall not contain XML schemas, CRS dictionaries or units of measure dictionary instance.

Note: GML instance data can be composed by a coverage description, metadata instances, annotation instances and feature instances and future extended elements.

The minimal structure case for the XML box packaging for a single codestream and for a multiple codestream is the same as shown in figure 6.



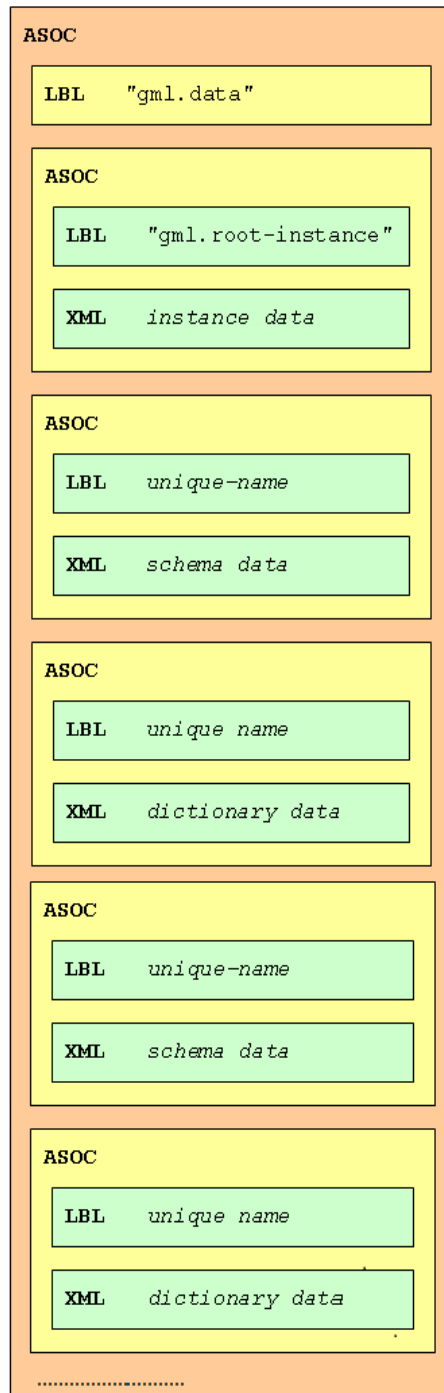
**Figure 5 — Minimal packaging of GML boxes**

XML schemas, CRS dictionaries or units of measure dictionaries can be stored as external XML files and referenced from the GMLJP2 file. In case that there is a need for storing them in the file, any number of association boxes may follow the `gml.root-instance` box as containers for them.

**Requirement 22 /req/jp2-other-inner-box**

Each of the association boxes, other than the `gml.root-instance` and `gml.data` boxes, shall have a label (the first box shall be a label box in each case). The value of the label is any value allowed by JPEG 2000 Part II.

This label is used in references to the XML box content using the mechanism described in Clause 10.6.



**Figure 6 — Packaging of GML Boxes for CRS dictionaries, XML schemas, and units of measure dictionaries stored internally**

**Note: the above boxes can also be stored as external XML files and referenced from the GMLJP2 file.**

## 10. XML references in a JPEG2000 package (core)

This clause describes the GMLJP2 URI syntax, a URI structure for references to schemas (`xsi:schemaLocation`) and instance elements or dictionary instance boxes, other XML data, or non-XML data through the use of URI references, e.g. `xlink:href`, `gml:uom`, `gml:srsName`, `gml:resultOf`. These can reside either externally or within the JPEG 2000 file. **GMLJP2 URIs are required for ALL references.**

### 10.1 References to XML schemas

GML instance data may reference a supporting XML schema (specifically, a GML application schema) through the XML schema location attribute (`xsi:schemaLocation`) whose value is a list of URI pairs (namespace, `schemaLocation`).

This standard has been crafted in a way that common uses (such as geographical georeferencing or including ISO metadata) do not require creating a specific application schema for each JPEG2000 instance and just using elements from the general schemas and referencing the general schemas could be enough. Nevertheless, it is possible that you need to define own GML feature types and feature collections or you own metadata schema. In this case, the specific application schema can be accessible in the web or can be included in a different XML box.

**Requirement 23 /gmljp2-schemalocation:** When XML schema definitions are embedded in a JPEG200 file, then `schemaLocation` attribute is mandatory.

#### Requirement 24 /req/gmljp2-xmlSchema

The GMLJP2 file processor should follow the assessment rules for schemas as laid out in XML Schema Specification, Part I Structures, Section 4.3.2.

For convenience these rules are repeated here:

Given a namespace name (or none) and (optionally) a URI reference from `xsi:schemaLocation` or `xsi:noNamespaceSchemaLocation`, schema-aware processors may implement any combination of the following strategies, in any order:

1. Do nothing, for instance because a schema containing components for the given namespace name is already known to be available, or because it is known in advance that no efforts to locate schema documents will be successful (for example in embedded systems);
2. Based on the location URI, identify an existing schema document, either as a resource which is an XML document or a `<schema>` element information item, in some local schema repository;
3. Based on the namespace name, identify an existing schema document, either as a resource which is an XML document or a `<schema>` element information item, in some local schema repository;
4. Attempt to resolve the location URI, to locate a resource on the web which is or contains or references a `<schema>` element;

5. Attempt to resolve the namespace name to locate such a resource. Whenever possible, configuration and/or invocation options for selecting and/or ordering the implemented strategies should be provided.

## 10.2 External references

References to external application schemas are possible and recommended for the common general schemas.

### **Requirement 25 /req/external-references**

**When an external application schema is referenced in the xsi:schemaLocation attribute or any resource is referenced in an xlink:href, it shall be referenced using a http://reference type to an XML instance, a relative reference shall be interpreted as relative to the jpeg2000 file position.**

Note that the relative reference meaning has been changed from the previous version of this standard. Where (in the previous version) the reference to the schemaLocation was done by URI using the GMLJP2 URI convention, with such references referring to schemas within the JPEG 2000 file.

## 10.3 Internal references within a JPEG2000 file.

### **Requirement 26 /req/internal-references**

**The structure of an internal GMLJP2 URI shall be as follows:  
gmljp2://[resource.type]/[resource.id]#[fragment-id]**

where

- gmljp2 is the URI scheme
- resource.type is one of the following:
  - xml codestream values for resource.id depend upon the value of resource.type, as explained below.
- values for fragment-identifier depend on the value of resource.type

## 10.4 Internal references to XML boxes within a JPEG2000 file

### **Requirement 27 /req/internal-references-to-xmlbox**

**When an specific application schema (xsi:schemaLocation) or any resource referenced (e.g. xlink:href) is included in a different XML Box it shall be referenced using a full reference. The URIs with a resource.type of xml identify a particular XML data box in the JPEG 2000 file shall have the following form: gmljp2://xml/[label] or gmljp2://xml/[label]#[id]**

where [label] identifies a labeled XML box within the gml.data box, and [id] is a GML id of an element inside the XML. If [id] is omitted, then the URI refers to the entire XML document.

**Dependencies:** /req/internal-references

Note that label text is arbitrary and is constrained only by the syntactical restrictions of the URI [IETF 2396] and of the label box in JPEG 2000 [ISO 15444-2].

GML instance documents may use URIs of this form to import schema, dictionary entries, or other XML data stored in the gml.data box.

EXAMPLE 1 gmljp2://xml/myschema.xsd

Identifies a schema in the XML box labelled myschema.xsd.

EXAMPLE 2 gmljp2://xml/uom.xml

Identifies a UOM dictionary in the XML box labelled uom.xml.

EXAMPLE 3 gmljp2://xml/uom.xml#meter

Identifies the meter entry in the UOM dictionary in the XML box labelled uom.xml. Note that instances, e.g. GML elements, can only be referenced within labeled boxes. This is an example of a notation that follows the above requirements:

```
<gmljp2:GMLJP2CoverageCollection gml:id="CCID1"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0" xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
http://schemas.opengis.net/gmljp2/2.0/gmljp2.xsd">
<gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>

      <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="RGC01_CCID1">
      <gml:boundedBy>
        <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSSG/0/4326" axisLabels="Lat
Long" uomLabels="deg deg" srsDimension="2">
          <gml:lowerCorner>1.0 1.0</gml:lowerCorner>
          <gml:upperCorner>3.0 10.0</gml:upperCorner>
        </gml:Envelope>
      </gml:boundedBy>
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="RG_RGC01_CCID1" dimension="2"
srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>0 0</gml:low>
              <gml:high>99 29</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisLabels>Lat Long</gml:axisLabels>
        </gml:RectifiedGrid>
      </gml:domainSet>
    </gmljp2:GMLJP2RectifiedGridCoverage>
  </gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>
```

```

    <gml:origin>
      <gml:Point gml:id="P0001_RGC01_CCID1">
        <!-- "Upper-left" image origin -->
        <gml:pos>2.95 1.05</gml:pos>
      </gml:Point>
    </gml:origin>
    <gml:offsetVector>0 0.1</gml:offsetVector>
    <gml:offsetVector>-0.1 0</gml:offsetVector>
  </gml:RectifiedGrid>
</gml:domainSet>
<gml:rangeSet>
  <gml:File>
    <gml:rangeParameters/>
    <gml:fileName>gmljp2://codestream/0</gml:fileName>
    <gml:fileStructure>Record Interleaved</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

## 10.5 Internal references to codestream within a JPEG2000 file

### **Requirement 28/req/internal-references-to-codestream**

A codestream shall be referenced using a full reference. URIs with resource.type of codestream identifying a particular codestream. These URIs have the following form: `gmljp2://codestream/[codestream-number]`

where [codestream-number] is an integer, greater than or equal to 0, that identifies a particular codestream in the JPEG 2000 file. By convention, codestreams are to be numbered in lexical order of their appearance in the file.

GML instance documents may use URIs of this form to refer to particular codestreams in the file.

EXAMPLE 1 `gmljp2://codestream/0`

Identifies the first codestream in the file.

EXAMPLE 2 `gmljp2://codestream/1`

Identifies the second codestream in the file.

**NOTE:** Care must be taken to preserve the integrity of such numerical codestream references when restructuring or rewriting the JPEG 2000 file in such a way that codestreams could get added, removed, or reordered; in other words, the codestream IDs are always in a strictly increasing order starting from 0.

## 10.6 Codestream references

### 10.6.1 Single codestream case

A single JPEG 2000 codestream is used to represent a single geographic 2D coverage. The GML data (instance data, schemas) associated within this codestream are contained in an association box as discussed in the next clause.

### 10.6.2 Minimal instance example for a single codestream

The GML data at the minimum, consists of a root `gmljp2:JPEG2000Coverage` which is a member of a codestream-specific coverage information, which in turn contains a `GMLCOV gmlcov:AbstractCoverage` member. This simple `RectifiedGridCoverage` example given below demonstrates the `GMLCOV` portion of the encoding of a georectified image as a `GMLCOV` coverage.

```
<gmljp2:GMLJP2CoverageCollection gml:id="CCID1"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0" xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
http://schemas.opengis.net/gmljp2/2.0/gmljp2.xsd">
  <gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>

      <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="RGC01_CCID1">
      <gml:boundedBy>
        <!-- Note: This boundedBy element for each Coverage member is recommended. -->
        <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSSG/0/4326" axisLabels="Lat
Long" uomLabels="deg deg" srsDimension="2">
          <gml:lowerCorner>1.0 1.0</gml:lowerCorner>
          <gml:upperCorner>3.0 10.0</gml:upperCorner>
        </gml:Envelope>
      </gml:boundedBy>
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="RG_RGC01_CCID1" dimension="2"
srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
```



```

    <gml:limits>
      <gml:GridEnvelope>
        <gml:low>0 0</gml:low>
        <gml:high>99 29</gml:high>
      </gml:GridEnvelope>
    </gml:limits>
    <gml:axisLabels>Lat Long</gml:axisLabels>
    <gml:origin>
      <gml:Point gml:id="P0001_RGC01_CCID1">
        <!-- "Upper-left" image origin -->
        <gml:pos>2.95 1.05</gml:pos>
      </gml:Point>
    </gml:origin>
    <gml:offsetVector>0 0.1</gml:offsetVector>
    <gml:offsetVector>-0.1 0</gml:offsetVector>
  </gml:RectifiedGrid>
</gml:domainSet>
<gml:rangeSet>
  <gml:File>
    <gml:rangeParameters/>
    <gml:fileName>gmljp2://codestream/0</gml:fileName>
    <gml:fileStructure>Record Interleaved</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

Note that the rangeSet is a required member of RectifiedGridCoverage, and so it must be included in the RectifiedGridCoverage. However, for GMLJP2 the range data is actually stored within the codestream in the JPEG 2000 file: there is no “file structure” to be specified. The rangeSet members are therefore set to “inapplicable” except fileName that is set to gmljp2://codestream/{codestream\_number}.

### 10.6.3 Multiple codestreams case

The multiple codestream encoding enables multiple images of the same or different type (different geometry, different radiometry) to be packaged in a single JPEG 2000 file. Stereo image pairs, triangulation blocks, orthoimagery with associated digital elevation models, and multi-source image assessment are examples of the use of multiple codestreams.

Note: The order of the gmljp2:GMLJP2RectifiedGridCoverage elements will usually be the same than the codestreams but the actual association of a gmljp2:JPEG2000Coverage element with its codestream is done by the fileName element in the rangeSet.

Some parts of the GMLJP2 XML could be repeated in the description of several codestreams. In this case, the use of gml:id and xlink:href general GML mechanism can be used to reference elements and avoid duplication.

The root element GMLJP2CoverageCollection can describe a collection of codestreams.. The first codestream is described by the 1<sup>st</sup> sub-elements of the collection and the next ones by further GMLJP2Coverage elements. These nested coverage collection description is shown in the example.

#### 10.6.4 Minimal instance example for multiple codestreams

The GML data, at the minimum, consists of a root gmljp2:JPEG2000RectifiedGridCoverage for each codestream.

```
<gmljp2:GMLJP2CoverageCollection gml:id="CCID1"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0" xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
http://schemas.opengis.net/gmljp2/2.0/gmljp2.xsd">
  <gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>
      <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="RGC01_CCID1">
      <gml:boundedBy>
        <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSSG/0/4326" axisLabels="Lat
Long" uomLabels="deg deg" srsDimension="2">
          <gml:lowerCorner>1.0 1.0</gml:lowerCorner>
          <gml:upperCorner>3.0 10.0</gml:upperCorner>
        </gml:Envelope>
      </gml:boundedBy>
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="RG_RGC01_CCID1" dimension="2"
srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>0 0</gml:low>
              <gml:high>99 29</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
        </gml:RectifiedGrid>
      </gml:domainSet>
    </gmljp2:GMLJP2RectifiedGridCoverage>
  </gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>
```

```

    <gml:axisLabels>Lat Long</gml:axisLabels>
    <gml:origin>
      <gml:Point gml:id="P0001_RGC01_CCID1">
        <!-- "Upper-left" image origin -->
        <gml:pos>2.95 1.05</gml:pos>
      </gml:Point>
    </gml:origin>
    <gml:offsetVector>0 0.1</gml:offsetVector>
    <gml:offsetVector>-0.1 0</gml:offsetVector>
  </gml:RectifiedGrid>
</gml:domainSet>
<gml:rangeSet>
  <gml:File>
    <gml:rangeParameters/>
    <gml:fileName>gmljp2://codestream/0</gml:fileName>
    <gml:fileStructure>Record Interleaved</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
<gmljp2:featureMember>
  <gmljp2:GMLJP2RectifiedGridCoverage gml:id="CodeStream1">
    <gml:domainSet>
      <gml:RectifiedGrid gml:id="RG_CodeStream1" dimension="2"
        srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
        <gml:limits>
          <gml:GridEnvelope>
            <gml:low>0 0</gml:low>
            <gml:high>8718 7812</gml:high>
          </gml:GridEnvelope>
        </gml:limits>
        <gml:axisLabels>Lat Long</gml:axisLabels>
        <gml:origin/>
        <gml:offsetVector/>
      </gml:RectifiedGrid>
    </gml:domainSet>
    <gml:rangeSet>
      <gml:File>
        <gml:rangeParameters/>
        <gml:fileName>gmljp2://codestream/1</gml:fileName>
        <gml:fileStructure>inapplicable</gml:fileStructure>
      </gml:File>
    </gml:rangeSet>
  </gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>

```

```

    <gmlcov:rangeType>
      <swe:DataRecord>
        <swe:field name="Panchromatic">
          <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
            <swe:description>Panchromatic Channel</swe:description>
            <swe:uom code="unity"/>
            <!-- Unity for value without unit of measures -->
          </swe:Quantity>
        </swe:field>
      </swe:DataRecord>
    </gmlcov:rangeType> </gmljp2:GMLJP2RectifiedGridCoverage>
  </gmljp2:featureMember>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="CodeStream2">
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="RG_CodeStream2" dimension="2"
          srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>0 0</gml:low>
              <gml:high>8718 7812</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisLabels>Lat Long</gml:axisLabels>
          <gml:origin/>
          <gml:offsetVector/>
        </gml:RectifiedGrid>
      </gml:domainSet>
      <gml:rangeSet>
        <gml:File>
          <gml:rangeParameters/>
          <gml:fileName>gmljp2://codestream/2</gml:fileName>
          <gml:fileStructure>inapplicable</gml:fileStructure>
        </gml:File>
      </gml:rangeSet>
    </gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Panchromatic">
        <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
          <swe:description>Panchromatic Channel</swe:description>
          <swe:uom code="unity"/>
          <!-- Unity for value without unit of measures -->
        </swe:Quantity>
      </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

## 11. Image annotation (informative)

### 11.1 Introduction

In general, an annotation is a combination of a representation feature of interest (FOI) in the real world, a styled label that annotates the feature (such as a text label, an image, a video, graphics, audio, etc) and an association (abstract or a graphical explicit representation e.g. a line or an arrow) (see figure 7). Annotations are intended for visualization so that they are deeply link with visualization styles.

In this standard, an annotation is an association between a label that annotates a JPEG2000 image or some geometric feature of interest (FOI) within the JPEG2000 image. The geometric properties of the FOI may be defined by a GML geometry, which can be a point, line string, etc in the same CRS coordinates than the image. If no geometric region is defined the annotation applies to the entire image, i.e. the JPEG 2000 codestream. Labels associated to FOIs may be defined using different encodings depending of the software that generates them.

As an illustrative example, this standard is proposing the use of a combination of GML and KML. The reason behind this is to complement the limitations of GML and KML. Regions of Interest and embedded geographic features (typed objects) are best expressed in GML since GML has a precise notion of feature types (while KML does not) and GML supports arbitrary CRS (current versions of KML only supports WGS84). HTML provides symbology for labels but the current versions of GML does not provide a recognized symbology mechanism (support for SVG introduced in GML 3.0 has been deprecated in newer versions). For the FOI the standard recommends the use GML (the application can portrayal in its own symbolization or cannot assume that the user will recognize them on the image). To describe the label to annotate the FOI KML is recommended (the application that portrayals it will be required to dynamically re-project the WGS84 KML data into the JPEG2000 CRS before presenting it). In addition, an explicit graphical association between the ROI and the label (e.g. a line or a curve) can be provided (the application that portrayals it can represent it if needed).

An alternative way of doing this mapping of the GML (feature type) to a SLD/SE symbolization that can also be packaged in the GMLJP2 so fulfilling requirements for disconnected systems. In this case, KML label could be generated on the fly from the GML and SDL/SE

In the future, the use of SLD/SE may enable the creation of a Portrayal Registry in which symbols, styles, etc are stored and reused by several JPEG2000 images.



**Figure 7 — Single annotation represented on top of a JPEG2000 image**

## 11.2 Use-cases

GMLJP2 is intended to handle a variety of annotation use cases including the following:

Example 1: Creating a GMLJP2 annotated image:

- Capture any object types (e.g. building – classify the building etc.) (GML)
- Apply a style to generate a symbolization (KML)
- Write the GML, KML and style (SLD/SE) into the GMLJP2 package

Example 2: Viewing a GMLJP2 annotated image

- Retrieve the symbolization (KML) from the GMLJP2 and visualize as image overlay

- Example 3: Apply user specified style to annotation in a GMLJP2 image

- Retrieve the object type (GML) from the GMLJP2 and apply User style to generate KML (or SVG etc) and then visualize as image overlay.

- Example 4: Apply default style to annotations in a GMLJP2 image

- Retrieve the object type (GML), SLD/SE from the GMLJP2 and apply the SLD/SE to generate KML and then visualize as image overlay.

- Currently, this standard does not provide any concrete annotation schema.

## Annex A Abstract Test Suite (normative)

A GMLJP2 implementation must satisfy the following system characteristics to be conformant with this specification.

Test identifiers below are relative to

<http://www.opengis.net/spec/GMLJP2/2.0>

### A.1 Conformance Test Class: core

The OGC URI identifier of this conformance class is:

<http://www.opengis.net/spec/GMLJP2/2.0/conf/core>

Tests identifiers below are relative to

<http://www.opengis.net/spec/GMLJP2/2.0/conf/core>

#### A.1.1 GMLJP2 file contains a GMLCOV coverage

**Test id:** `/conf/core/gmljp2-gmlcov`

**Test Purpose:** **Requirement** [/req/gmljp2-gmlcov](#): A GMLJP2 encoded file conformant to this standard shall use a GMLCOV coverage description following the OGC12-108 GML Application Schema - Coverages - JPEG2000 Coverage Encoding Extension to describe the coverage collection and to describe the individual coverages.

**Test method:** Check if the GMLJP2 XML instances use elements from the <http://www.opengis.net/gmlcov/1.0>. Test passes if <http://www.opengis.net/gmlcov/1.0> is used.

#### A.1.2 GMLJP2 coverage metadata coherence with JPEG2000 header

**Test id:** `/conf/core/header-precedence`

**Test Purpose:** **Requirement** [/req/header-precedence](#): Coverage metadata in a GMLJP2 XML instance about the internal structure of the JPEG2000 file (e.g. number of codestreams, number of rows and columns of a codestream) shall be coherent with the JPEG2000 binary header information. In case of discrepancies the JPEG2000 binary headers information takes precedence.

**Test method:** Verify that the image headers values are the same that are included in the GMLJP2 XML instance. Test passes if they are the same.

#### A.1.3 GMLJP2 file GMLCOV precedence

**Test id:** `/conf/core/gmlcov-precedence`

**Test Purpose:** **Requirement /req/gmlcov-precedence:** gmlcov:metadata information shall be coherent with the corresponding GMLCOV information in gml:domainSet or gmlcov:rangeType (e.g. geometric or radiometric information in ISO19139 format).

**Test method:** Verify if the redundant information in the gmlcov:metadata and in the corresponding elements of gmlcov is the same. Test passes if it is the same.

#### **A.1.4 Usage of gmlcov:metadata instead of gml:metaDataProperty**

**Test id:** /conf/core/gml-metaDataProperty

**Test Purpose:** **Requirement /req/gml-metaDataProperty:** gml:metaDataProperty shall neither encode metadata about the coverage collection nor the individual coverages.

**Test method:** Verify that gml:metaDataProperty is not used in the coverage collection and in the individual coverages. Test passes if it is not used.

#### **A.1.5 CRS is well defined externally by URI**

**Test id:** /conf/core/gmlcov-CRS-byref

**Test Purpose:** **Requirement /req/gmlcov-CRS-byref:** CRS SHALL be identified by URI following the OGC document OGC 11-135 and maintained in <http://www.opengis.net/def>.

**Test method:** Verify that CRS are declared using URIs. Test passes if all CRSs are URIs.

#### **A.1.6 CRS is defined for rectified coverages**

**Test id:** /conf/core/gmlcov-RectifiedGridCoverage-CRS

**Test Purpose:** **Requirement /req/gmlcov-RectifiedGridCoverage-CRS**

**Test method:** Verify that all GMLJP2RectifiedGridCoverage have CRS defined in the domainSet. Test passes all GMLJP2RectifiedGridCoverage have a CRSs defined.

#### **A.1.7 UoM in rangeType are defined when applicable**

**Test id:** /conf/core/gmlcov-rangetype-uom

**Test Purpose:** **Requirement /req/gmlcov-rangetype-uom**

**Test method:** Verify that all swe:DataRecords that declare variables that requires units have them populated (gmlcov:rangeType/swe:DataRecord/swe:uom).



Test passes if they are present.

#### **A.1.8 UoM are defined by reference**

**Test id:** /conf/core/gmlcov-uom-byref

**Test Purpose:** Requirement /req/gmlcov-uom-byref

**Test method:** Verify if all UoM in the GMLJP2 XML document are defined using URIs. Test passes if all are URIs.

#### **A.1.9 GMLJP2 file gmlcov-nil-values**

**Test id:** /conf/core/gmlcov-nil-values

**Test Purpose:** Requirement /req/gmlcov-nil-values

**Test method:** Verify that the tag nil-values have value and a reason. Test passes if all these have it.

#### **A.1.10 Nil-values by reference**

**Test id:** /conf/core/gmlcov-nil-reason-byref

**Test Purpose:** Requirement /req/gmlcov-nil-reason-byref: In those cases where the reason is identified by reference to an authority and code, it SHALL be identified by URI following the OGC document [09-046r2].

**Test method:** Verify that the all reasons for null values are defined as URI's. Test passes if there are.

#### **A.1.11 GMLJP2 file root is a coverage collection**

**Test id:** /conf/core/gmlcov-coverage-collection-container

**Test Purpose:** Requirement /req/gmlcov-coverage-collection-container

**Test method:** Verify that the root element is a gmljp2:GMLJP2CoverageCollection and the elements gml:domainSet, the gml:rangeSet and the gmlcov:rangeType have been populated according to requirement 11. Test passes if the root is as expected.

#### **A.1.12 GMLJP2 file coverages**

**Test id:** /conf/core/gmlcov-coverage-container

**Test Purpose:** Requirement /req/gmlcov-coverage-container

**Test method:** Verify that there are as many gmljp2:featureMembers derived from gmlcov:AbstractCoverageType as codestreams are present in the image. Test passes if both numbers are equal.

#### **A.1.13 GMLJP2 file gmlcov-metadata**

**Test id:** /conf/core/gmlcov-metadata

**Test Purpose:** Requirement /req/gmlcov-metadata

**Test method:** Verify the presence of the gmlcov-metadata if metadata is available. If so, test passes if gmlcov-metadata is populated.

#### **A.1.14 GMLJP2 file features**

**Test id:** /conf/core/gmlcov-feature-container

**Test Purpose:** Requirement /req/gml-feature-container

**Test method:** Verify that gmljp2:GMLJP2Features (for features common to all codestreams) or gmljp2:feature (for features that are related to a single codestream) contain features as necessary that are not coverages or annotations. If so, test passes if these features are not coverages or annotations.

#### **A.1.15 GMLJP2 file annotations**

**Test id:** /conf/core/annotation-container

**Test Purpose:** Requirement /req/annotation-container

**Test method:** Verify that annotations are contained only in the gmljp2:annotation element as specified. Test passes if they are.

#### **A.1.16 GMLJP2 file styles**

**Test id:** /conf/core/annotation-container

**Test Purpose:** Requirement /req/style-container

**Test method:** Verify that style information is contained only in the gmljp2:style element as specified. If so, test passes.

#### **A.1.17 GMLJP2 file /req/gmlcov-filename-codestream**

**Test id:** /conf/core/gmlcov-filename-codestream

**Test Purpose:** Requirement /req/filename-codestream

**Test method:** Verify the correspondence of the rangeSet members fileName and fileStructure are populated as gmljp2://codestream/# (# being a number) and inapplicable. If so, test passes.

**A.1.18 GMLJP2 file XML boxes**

**Test id:** /conf/core/xml-boxes

**Test Purpose:** Requirement /req/xml-boxes

**Test method:** Verify that the image file has an XML box and association box with label that may serve as an identifier in GMLJP2 descriptions. If so, test passes.

**A.1.19 GMLJP2 file XML boxes signaled correctly**

**Test id:** /conf/core/xml-box-signal

**Test Purpose:** Requirement /req/xml-box-signal

**Test method:** Verify that the XML box is signaled with the value 67 indicating GML or Geographic metadata (XMLGISMetaData). If so, test passes.

**A.1.20 GMLJP2 file is a jp2 compatible**

**Test id:** /conf/core/jp2-compatible

**Test Purpose:** Requirement /req/jp2-compatible

**Test method:** Verify that the JPEG 2000 is marked as “jp2” in the compatibility list. If so, test passes.

**A.1.21 GMLJP2 file /req/ jp2-outer-box**

**Test id:** /conf/core/jp2-outer-box

**Test Purpose:** Requirement /req/jp2-outer-box

**Test method:** Verify the structure and naming of the boxes and outer box is as specified, with the XML instance data preceded by a label box with the label gml.root-instance. If so, test passes.

**A.1.22 GMLJP2 file /req/jp2-other-outer-box**

**Test id:** /conf/core/jp2-other-outer-box

**Test Purpose:** Requirement /req/jp2-other-inner-box

**Test method:** Verify the structure and naming of the boxes is as specified. If so, test

passes.

**A.1.23 GMLJP2 file /req/gmlcov-schemalocation**

**Test id:** /conf/core/gmljp2-schemalocation

**Test Purpose:** Requirement /req/gmljp2-schemalocation

**Test method:** Verify that when a XML resource embedded in a JPEG200 file includes a schema definition, a reference to a schemaLocation is provided. If so, test passes.

**A.1.24 GMLJP2 file /req/external-references**

**Test id:** /conf/core/external-references

**Test Purpose:** Requirement /req/external-references

**Test method:** Verify that the external references to schemaLocations are made using http references. If so, test passes.

**A.1.25 GMLJP2 file /req/internal-references**

**Test id:** /conf/core/internal-references

**Test Purpose:** Requirement /req/internal-references

**Test method:** Verify that the internal references to schemaLocations are made using gmljp2: references. If so, test passes.

**A.1.26 GMLJP2 file /req/internal-references-to-xmlbox**

**Test id:** /conf/core/internal-references-to-xmlbox

**Test Purpose:** Requirement /req/internal-references-to-xmlbox

**Test method:** Verify that the internal references to schemaLocations in xmlboxes are made using gmljp2://xml/ references. If so, test passes.

**A.1.27 GMLJP2 file /req/internal-references-to-codestream**

**Test id:** /conf/core/ internal-references-to-codestream

**Test Purpose:** Requirement /req/internal-references-to-codestream

**Test method:** Verify that the internal references to schemaLocations in codestreams are made using gmljp2://codestream/ references. If so, test passes.

## Annex B UML diagrams (informative)

This annex provides a UML class model of the GMLJP2 XML data structure defined in the Section 8. Figure 8 diagram shows that a GMJP2CoverageCollection is composed by featureMember's that can be GMLJP2ReferenceableGridCoverage, GMLJP2GridCoverage or GMLJP2ReferencedGridCoverage (one for each codestream) all of them derived from the abstract GMLJP2Coverage that is extended from the GMLCOV::DiscreteCoverage and includes features, styles and annotations. GMLJP2ReferenceableGridCoverage can additionally contain generic features and styles. The model contains many extension points for future extensions. In particular, the extension point of GMLCOV::Coverage is used to specifically contain metadata of several types.

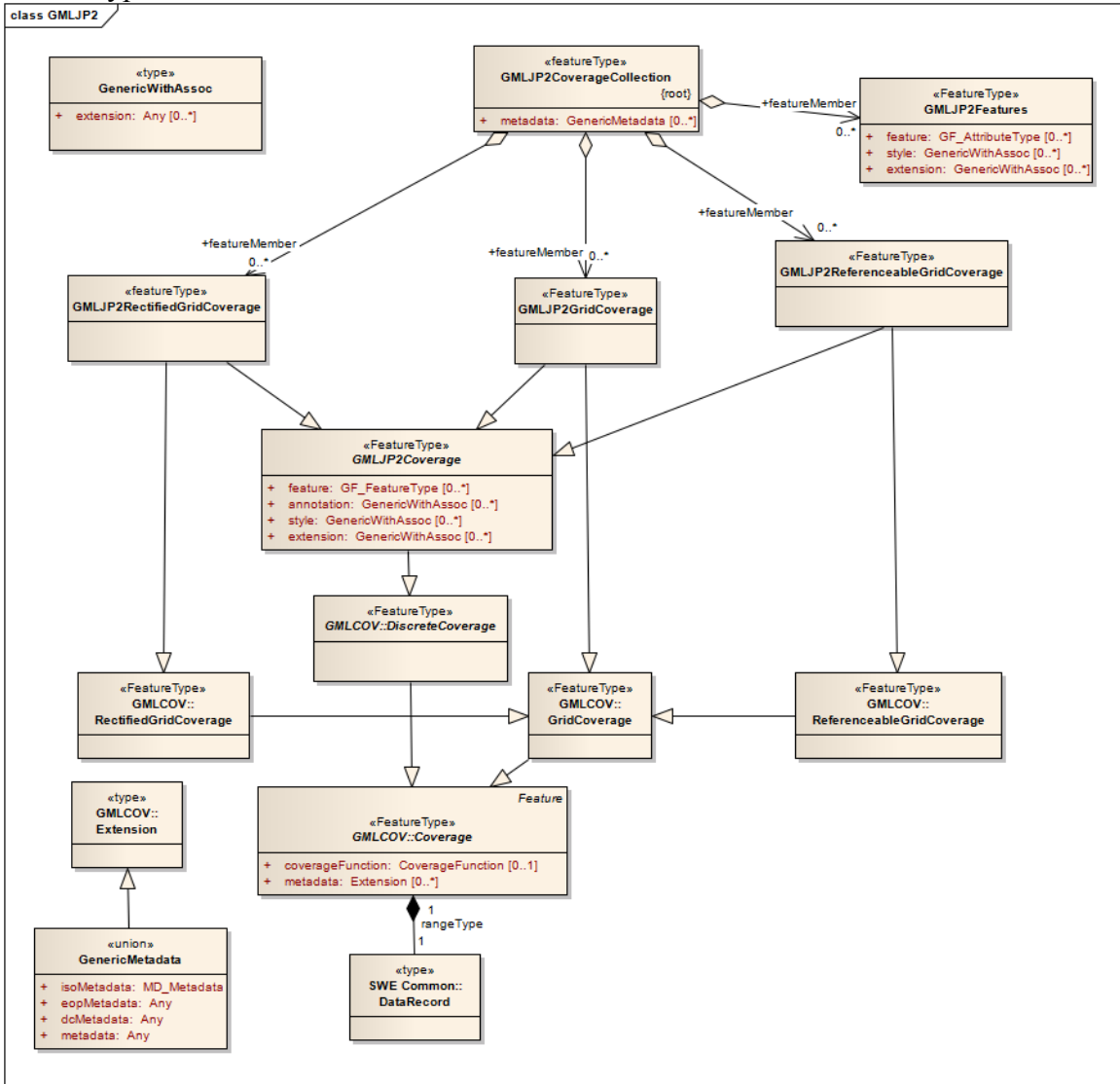


Figure 8 —GMLJP2 data structure UML diagram

## Annex C XML Schemas documents (informative)

In addition to this document, this standard includes some normative XML Schema Documents. These XML Schema Documents are bundled in a zip file with the present document. After OGC acceptance of a Version 2.0 of this standard, these XML Schema Documents will also be posted online at the URL <http://schemas.opengis.net/gmljp2/2.0.0>. In the event of a discrepancy between the bundled and online versions of the XML Schema Documents, the online files SHALL be considered authoritative.

This XML Schema Document is named:

gmljp2.xsd

These XML Schema Documents use and build on GML 3.2.1 and GMLCov 1.0 XML Schemas

The GMLJP2 application schema is included in this annex: gmlJP2.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:eop="http://www.opengis.net/eop/2.0"
  xmlns:dc="http://purl.org/dc/elements/1.1/"
  targetNamespace="http://www.opengis.net/gmljp2/2.0"
  elementFormDefault="qualified"
  version="2.0.0 2014-09-16">
  <annotation>
    <appinfo>GMPJP2</appinfo>
    <documentation>This XML Schema Document defines the GMLJP2 XML
encoding described in OGC 08-085r4.

        GMLJP2 is an OGC Standard.
        Copyright (c) 2014 Open Geospatial Consortium.
        To obtain additional rights of use, visit
http://www.opengeospatial.org/legal/.
    </documentation>
  </annotation>
  <import namespace="http://www.w3.org/1999/xlink"
    schemaLocation="http://www.w3.org/1999/xlink.xsd"/>
  <import namespace="http://www.opengis.net/gmlcov/1.0"

schemaLocation="http://schemas.opengis.net/gmlcov/1.0/gmlcovAll.xsd"/>
  <import namespace="http://www.opengis.net/gml/3.2"
    schemaLocation="http://schemas.opengis.net/gml/3.2.1/gml.xsd"/>
  <import namespace="http://www.isotc211.org/2005/gmd"

schemaLocation="http://schemas.opengis.net/iso/19139/20070417/gmd/gmd.xs
d"/>
  <import namespace="http://www.opengis.net/eop/2.0"
```

```

        schemaLocation="http://schemas.opengis.net/omeo/1.0/eop.xsd"/>
    <import namespace="http://purl.org/dc/elements/1.1/"
        schemaLocation="http://schemas.opengis.net/csw/2.0.2/rec-
dcmes.xsd"/>
    <!-- =====
                    GMLJP2 Root elements and type
=====-->
    <element name="GMLJP2CoverageCollection"
type="gmljp2:GMLJP2CoverageCollectionType"
substitutionGroup="gmlcov:AbstractCoverage">
    <annotation>
        <documentation>This is the root element of a GMLJP2 XML
description of an image, and serves as a container for all other
elements (as stated in Requirement 11). The sub-elements gml:domainSet,
the gml:rangeSet and the gmlcov:rangeType shall be left as blank as
possible because these sub-elements have no meaning for the collection
(but are inherited from the GMLCOV schema); the domainSet should provide
a CRS information (defaulted to WGS84, otherwise the CRS of the single
coverage or the common CRS of all coverages included - if the CRS is
homogeneous -), and the bounding box for the collection.</documentation>
    </annotation>
</element>
    <complexType name="GMLJP2CoverageCollectionType">
        <complexContent>
            <extension base="gmlcov:AbstractCoverageType">
                <sequence>
                    <element name="featureMember" maxOccurs="unbounded">
                        <complexType>
                            <complexContent>
                                <extension
base="gml:AbstractFeatureMemberType">
                                    <sequence>
                                        <choice maxOccurs="unbounded">
                                            <element
ref="gmljp2:GMLJP2GridCoverage"/>
                                            <element
ref="gmljp2:GMLJP2RectifiedGridCoverage"/>
                                            <element
ref="gmljp2:GMLJP2ReferenceableGridCoverage"/>
                                            <element
ref="gmljp2:GMLJP2Features"/>
                                        </choice>
                                    </sequence>
                                <attributeGroup
ref="gml:AssociationAttributeGroup"/>
                            </extension>
                        </complexContent>
                    </complexType>
                </element>
                <element name="style"
type="gmljp2:GenericWithAssocPropertyType" minOccurs="0"
maxOccurs="unbounded">
                    <annotation>
                        <documentation>When styling information of
the features or annotations common to all codestreams in the JPEG 2000
file should be included independent from the features, these styles
shall be included in this element (as stated in Requirement

```

```

16)..</documentation>
        </annotation>
      </element>
      <element name="extension"
type="gmljp2:GenericWithAssocPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
    </sequence>
  </extension>
</complexContent>
</complexType>
<element name="GMLJP2GridCoverage" type="gmljp2:GMLJP2CoverageType"
substitutionGroup="gmlcov:GridCoverage">
  <annotation>
    <documentation>For each codestream present in the image that
can be considered a grid coverage, gmljp2:GMLJP2GridCoverage shall be
provided and populated (by a description of the gml:domainSet, the
gml:rangeSet and the gmlcov:rangeType) (as stated in Requirement
12).</documentation>
  </annotation>
</element>
<element name="GMLJP2RectifiedGridCoverage"
type="gmljp2:GMLJP2CoverageType"
substitutionGroup="gmlcov:RectifiedGridCoverage">
  <annotation>
    <documentation>For each codestream present in the image,
that can be considered a rectified coverage grid,
gmljp2:GMLJP2RectifiedGridCoverage shall be provided and populated (by a
description of the gml:domainSet, the gml:rangeSet and the
gmlcov:rangeType) (as stated in Requirement 12).</documentation>
  </annotation>
</element>
<element name="GMLJP2ReferenceableGridCoverage"
type="gmljp2:GMLJP2CoverageType"
substitutionGroup="gmlcov:ReferenceableGridCoverage">
  <annotation>
    <documentation>For each codestream present in the image,
that can be considered a referenceable coverage grid,
gmljp2:GMLJP2ReferenceableGridCoverage shall be provided and populated
(by a description of the gml:domainSet, the gml:rangeSet and the
gmlcov:rangeType) (as stated in Requirement 12).</documentation>
  </annotation>
</element>
<element name="GMLJP2Features" type="gmljp2:GMLJP2FeaturesType"
substitutionGroup="gml:AbstractFeature">
  <annotation>
    <documentation>When there are features common to all
codestreams in the JPEG 2000 file, they should be included (except the
GMLCOV part and annotations if any) in this element. These features
shall be encoded in GML 3.2. From features that are related to a single
codestream use the gmljp2:feature element of the GMLJP2 elements derived
from gmljp2:GMLJP2CoverageType (i.e. gmljp2:GMLJP2GridCoverage,
gmljp2:GMLJP2RectifiedGridCoverage or
gmljp2:GMLJP2ReferenceableGridCoverage) (as stated in Requirement
14).</documentation>
  </annotation>
</element>
<complexType name="GMLJP2FeaturesType">

```



```

    <complexContent>
      <extension base="gml:AbstractFeatureType">
        <sequence>
          <element name="feature">
            <complexType>
              <complexContent>
                <extension
base="gml:AbstractFeatureMemberType">
                  <sequence>
                    <element
ref="gml:AbstractFeature" minOccurs="0" maxOccurs="unbounded" />
                  </sequence>
                  <attributeGroup
ref="gml:AssociationAttributeGroup" />
                </extension>
              </complexContent>
            </complexType>
          </element>
          <element name="style"
type="gmljp2:GenericWithAssocPropertyType" minOccurs="0"
maxOccurs="unbounded">
            <annotation>
              <documentation>When styling information of
the parent features should be included independent from the features,
these styles shall be included in this element (as stated in Requirement
16). For example, it can include an SLD as a style layer description
that describes styles of the parent element features.</documentation>
            </annotation>
          </element>
          <element name="extension"
type="gmljp2:GenericWithAssocPropertyType" minOccurs="0"
maxOccurs="unbounded" />
        </sequence>
      </extension>
    </complexContent>
  </complexType>
<!-- =====
                        GMLJP2 coverage for a codestrem
=====-->
  <complexType name="GMLJP2CoverageType">
    <annotation>
      <documentation>For each codestream present in the image, a
single child gmljp2:featureMember derived from
gmlcov:AbstractCoverageType (i.e. gmljp2:GMLJP2GridCoverage,
gmljp2:GMLJP2RectifiedGridCoverage or
gmljp2:GMLJP2ReferenceableGridCoverage) (composed by a description of
the gml:domainSet, the gml:rangeSet and the gmlcov:rangeType with the
addition of features, annotations and styles) shall be provided and
populated (as atated in Requirement 12).</documentation>
    </annotation>
    <complexContent>
      <extension base="gmlcov:AbstractDiscreteCoverageType">
        <sequence>
          <element name="feature"
type="gml:FeaturePropertyType" minOccurs="0" maxOccurs="unbounded">
            <annotation>
              <documentation>When there are features

```

```

related to a single codestream in the JPEG 2000 file, that should be
included (except the GMLCOV part and annotations if any) here. These
features shall be encoded in GML 3.2. From features that are common to
all codestreams use GMLJP2Features.</documentation>
    </annotation>
  </element>
  <element name="annotation"
type="gmljp2:GenericWithAssocPropertyType" minOccurs="0"
maxOccurs="unbounded">
    <annotation>
      <documentation>When there are annotations
related the JPEG 2000 file that should be included as child elements of
this element (as stated in Requirement 15).</documentation>
    </annotation>
  </element>
  <element name="style"
type="gmljp2:GenericWithAssocPropertyType" minOccurs="0"
maxOccurs="unbounded">
    <annotation>
      <documentation>When styling information of
the features or annotations related to a single codestream in the JPEG
2000 file should be included independent from the features, these styles
shall be included in this element (as stated in Requirement 16). For
example, it can include an SLD as a style layer description that
describes styles of the gmljp2:feature element.</documentation>
    </annotation>
  </element>
  <element name="extension"
type="gmljp2:GenericWithAssocPropertyType" minOccurs="0"
maxOccurs="unbounded">
    <annotation>
      <documentation>Generic extension
point.</documentation>
    </annotation>
  </element>
</sequence>
</extension>
</complexContent>
</complexType>
<!-- =====
Metadata Types
===== -->
  <element name="Metadata" type="gmljp2:GenericMetadataType"
substitutionGroup="gmlcov:Extension">
    <annotation>
      <documentation>If needed, coverage metadata descriptions
shall be included this element by attaching it to the gmlcov:metadata of
the gmljp2:featureMember derived from gmlcov:AbstractCoverageType (as
stated in Requirement 14). This element provides placeholders for ISO
19139 Metadata (isoMetadata), the Earth Observation Profile metadata
(eopMetadata) Dublin Core metadata (dcMetadata), textual metadata
(metadata) or any other form of metadata (metadata).</documentation>
    </annotation>
  </element>
  <complexType name="GenericMetadataType">
    <complexContent>
      <restriction base="gmlcov:ExtensionType">

```

```

        <sequence>
            <choice minOccurs="0">
                <element name="isoMetadata"
type="gmd:MD_Metadata_PropertyType" />
                <element name="eopMetadata"
maxOccurs="unbounded">
                    <complexType>
                        <sequence>
                            <element
ref="eop:EarthObservation" />
                        </sequence>
                    </complexType>
                </element>
                <element name="dcMetadata"
maxOccurs="unbounded">
                    <complexType>
                        <sequence minOccurs="0"
maxOccurs="unbounded">
                            <element ref="dc:DC-element" />
                        </sequence>
                    </complexType>
                </element>
                <element name="metadata">
                    <complexType mixed="true">
                        <sequence>
                            <any namespace="##other"
processContents="lax" minOccurs="0" maxOccurs="unbounded" />
                        </sequence>
                        <attributeGroup
ref="gml:AssociationAttributeGroup" />
                    </complexType>
                </element>
            </choice>
        </sequence>
    </restriction>
</complexContent>
</complexType>
<!-- =====>
                                Generic Types
=====-->
    <complexType name="GenericWithAssocPropertyType">
        <sequence>
            <any namespace="##other" processContents="lax" />
        </sequence>
        <attributeGroup ref="gml:AssociationAttributeGroup">
            <annotation>
                <documentation>All child elements in the
gmljp2:GMLJP2CoverageType are derived from gml:AssociationAttributeGroup
and can be described in-line or by referencing other elements of the
same XML or from different XML using xlink:href.</documentation>
            </annotation>
        </attributeGroup>
    </complexType>
</schema>

```

## Annex D GMLJP2 examples (informative)

### D.1. ISO19115-ISO19139 metadata example

```

<?xml version="1.0" encoding="UTF-8"?>
<gmljp2:GMLJP2CoverageCollection gml:id="JPEG2000_0"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
http://schemas.opengis.net/gmljp2/2.0/gmlJP2.xsd"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0"
xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>
      <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="ID_1">
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="rg0001_C0002" dimension="2"
          srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>0 0</gml:low>
              <gml:high>6208 3103</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisLabels>Lat Long</gml:axisLabels>
          <gml:origin>
            <gml:Point gml:id="P0001">
              <gml:pos>41.4756576954751 2.04345415526392</gml:pos>
            </gml:Point>
          </gml:origin>
          <gml:offsetVector>0 3.71e-005</gml:offsetVector>
          <gml:offsetVector>-3.71e-005 0</gml:offsetVector>
        </gml:RectifiedGrid>
      </gml:domainSet>
      <gml:rangeSet>
        <gml:File>
          <gml:rangeParameters/>
          <gml:fileName>gmljp2://codestream/0</gml:fileName>
        </gml:File>
      </gml:rangeSet>
    </gmljp2:GMLJP2RectifiedGridCoverage>
  </gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

```

    <gml:fileStructure>inapplicable</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>    <gmlcov:metadata>
  <gmljp2:Metadata>
    <gmljp2:isoMetadata>
      <gmd:MD_Metadata>
        <gmd:fileIdentifier><gco:CharacterString>111111</gco:CharacterString>
        </gmd:fileIdentifier>
        <gmd:hierarchyLevel>
          <gmd:MD_ScopeCode
codeListValue="http://schemas.opengis.net/iso/19139/20070417/resources/C
odelist/ML_gmxCodelists.xml#MD_ScopeCode"
codeList="dataset">dataset</gmd:MD_ScopeCode></gmd:hierarchyLevel>
          <gmd:hierarchyLevelName>
            <gco:CharacterString>dataset</gco:CharacterString>
          </gmd:hierarchyLevelName>
          <gmd:contact>
            <gmd:CI_ResponsibleParty>
              <gmd:individualName>
                <gco:CharacterString>GRAMP</gco:CharacterString>
              </gmd:individualName>
              <gmd:organisationName>
                <gco:CharacterString>Departament de Geografia,
UAB</gco:CharacterString>
              </gmd:organisationName>
              <gmd:contactInfo>
                <gmd:CI_Contact>
                  <gmd:phone>
                    <gmd:CI_Telephone>
                      <gmd:voice>
                        <gco:CharacterString>+34 93 581 41
33</gco:CharacterString>
                      </gmd:voice>
                    </gmd:CI_Telephone>
                  </gmd:phone>
                  <gmd:address>
                    <gmd:CI_Address>
                      <gmd:city>
                        <gco:CharacterString>Cerdanyola del
Valles</gco:CharacterString>
                      </gmd:city>
                      <gmd:postalCode>
                        <gco:CharacterString>08193</gco:CharacterString>
                      </gmd:postalCode>
                    </gmd:address>
                  </gmd:CI_Address>
                </gmd:CI_Contact>
              </gmd:contactInfo>
            </gmd:CI_ResponsibleParty>
          </gmd:contact>
        </gmd:MD_Metadata>
      </gmljp2:isoMetadata>
    </gmljp2:Metadata>
  </gmlcov:metadata>
</gmlcov:rangeType>

```

```

        <gmd:electronicMailAddress>
<gco:CharacterString>joanmanuel.soriano@uab.cat</gco:CharacterString>
        </gmd:electronicMailAddress>
    </gmd:CI_Address>
</gmd:address>
    <gmd:onlineResource>
<gmd:CI_OnlineResource>
    <gmd:linkage>
<gmd:URL>http://mediterrani.uab.es/web/catala/index.htm</gmd:URL>
    </gmd:linkage>
    <gmd:function>
    <gmd:CI_OnLineFunctionCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#CI_OnLineFunctionCode"
codeListValue="information">Informacio</gmd:CI_OnLineFunctionCode>
    </gmd:function>
    </gmd:CI_OnlineResource>
</gmd:onlineResource>
</gmd:CI_Contact>
</gmd:contactInfo>
    <gmd:role>
    <gmd:CI_RoleCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#CI_RoleCode" codeListValue="originator">Creador</gmd:CI_RoleCode>
    </gmd:role>
    </gmd:CI_ResponsibleParty>
</gmd:contact>
    <gmd:dateStamp>
<gco>Date>2006-12-13</gco>Date>
    </gmd:dateStamp>
    <gmd:metadataStandardName>
<gco:CharacterString>ISO 19115:2003/Cor.1:2006 Geographic
Information - Metadata</gco:CharacterString>
    </gmd:metadataStandardName>
    <gmd:metadataStandardVersion>
<gco:CharacterString>IS</gco:CharacterString>
    </gmd:metadataStandardVersion>
    <gmd:spatialRepresentationInfo>
<gmd:MD_Georectified>
    <gmd:numberOfDimensions>
<gco:Integer>2</gco:Integer>
    </gmd:numberOfDimensions>
    <gmd:axisDimensionProperties>
<gmd:MD_Dimension>
    <gmd:dimensionName>
    <gmd:MD_DimensionNameTypeCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#MD_DimensionNameTypeCode"
codeListValue="row">Fila</gmd:MD_DimensionNameTypeCode>
    </gmd:dimensionName>
    <gmd:dimensionSize>
<gco:Integer>7734</gco:Integer>
    </gmd:dimensionSize>
    <gmd:resolution>
<gco:Length uom="m">1</gco:Length>
    </gmd:resolution>

```

```

        </gmd:MD_Dimension>
        </gmd:axisDimensionProperties>
        <gmd:axisDimensionProperties>
        <gmd:MD_Dimension>
            <gmd:dimensionName>
            <gmd:MD_DimensionNameTypeCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#MD_DimensionNameTypeCode"
codeListValue="column">Columna</gmd:MD_DimensionNameTypeCode>
            </gmd:dimensionName>
            <gmd:dimensionSize>
            <gco:Integer>7950</gco:Integer>
            </gmd:dimensionSize>
            <gmd:resolution>
            <gco:Length uom="m">1</gco:Length>
            </gmd:resolution>
        </gmd:MD_Dimension>
        </gmd:axisDimensionProperties>
        <gmd:cellGeometry>
        <gmd:MD_CellGeometryCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#MD_CellGeometryCode"
codeListValue="area">Area</gmd:MD_CellGeometryCode>
            </gmd:cellGeometry>
            <gmd:transformationParameterAvailability>
            <gco:Boolean>>true</gco:Boolean>
            </gmd:transformationParameterAvailability>
            <gmd:checkPointAvailability>
            <gco:Boolean>>false</gco:Boolean>
            </gmd:checkPointAvailability>
            <gmd:pointInPixel>
        <gmd:MD_PixelOrientationCode>center</gmd:MD_PixelOrientationCode>
            </gmd:pointInPixel>
        </gmd:MD_Georectified>
        </gmd:spatialRepresentationInfo>
        <gmd:referenceSystemInfo>
        <gmd:MD_ReferenceSystem>
            <gmd:referenceSystemIdentifier>
            <gmd:RS_Identifier>
                <gmd:code>
                <gco:CharacterString>EPSG:23031</gco:CharacterString>
                </gmd:code>
            </gmd:RS_Identifier>
            </gmd:referenceSystemIdentifier>
        </gmd:MD_ReferenceSystem>
        </gmd:referenceSystemInfo>
        <gmd:identificationInfo>
        <gmd:MD_DataIdentification>
            <gmd:citation>
            <gmd:CI_Citation>
                <gmd:title>
                <gco:CharacterString>Finestra de Vol america 1956-57.
Fotograma: 28464; passada: 280; full IGN: 445; data: 05-10-
1956</gco:CharacterString>
                </gmd:title>
                <gmd:date>

```

```

    <gmd:CI_Date>
      <gmd:date>
        <gco:Date>2006-12-01</gco:Date>
      </gmd:date>
      <gmd:dateType>
        <gmd:CI_DateTypeCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#CI_DateTypeCode"
codeListValue="creation">Creacio</gmd:CI_DateTypeCode>
        </gmd:dateType>
      </gmd:CI_Date>
    </gmd:date>
    <gmd:editionDate>
      <gco:Date>2006-12-01</gco:Date>
    </gmd:editionDate>
  </gmd:CI_Citation>
</gmd:citation>
<gmd:abstract>
  <gco:CharacterString>Correccio geometrica d'un fotograma
escanejat, a resolucio de 800 DPI, corresponent al vol america realitzat
entre 1956 i 1957. Es tracta del full 445 del Instituto Geografico
Nacional (IGN).</gco:CharacterString>
  </gmd:abstract>
  <gmd:pointOfContact>
    <gmd:CI_ResponsibleParty>
      <gmd:individualName>
        <gco:CharacterString>GRAMP</gco:CharacterString>
      </gmd:individualName>
      <gmd:organisationName>
        <gco:CharacterString>Departament de Geografia,
UAB</gco:CharacterString>
      </gmd:organisationName>
      <gmd:contactInfo>
        <gmd:CI_Contact>
          <gmd:address>
            <gmd:CI_Address>
              <gmd:city>
                <gco:CharacterString>Cerdanyola del
Valles</gco:CharacterString>
              </gmd:city>
              <gmd:postalCode>
                <gco:CharacterString>08193</gco:CharacterString>
              </gmd:postalCode>
              <gmd:electronicMailAddress>
                <gco:CharacterString>joanmanuel.soriano@uab.cat</gco:CharacterString>
              </gmd:electronicMailAddress>
            </gmd:CI_Address>
          </gmd:address>
        </gmd:CI_Contact>
      </gmd:contactInfo>
      <gmd:role>
        <gmd:CI_RoleCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#CI_RoleCode" codeListValue="originator">Creador</gmd:CI_RoleCode>
      </gmd:role>
    </gmd:CI_ResponsibleParty>
  </gmd:abstract>

```



```

        </gmd:pointOfContact>
        <gmd:descriptiveKeywords>
        <gmd:MD_Keywords>
            <gmd:keyword>
                <gco:CharacterString>Fotografia
Aeria</gco:CharacterString>
            </gmd:keyword>
        </gmd:keyword>
        <gmd:type>
            <gmd:MD_KeywordTypeCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#MD_KeywordTypeCode"
codeListValue="theme">Tema</gmd:MD_KeywordTypeCode>
        </gmd:type>
    </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
<gmd:language>
<gmd:LanguageCode
codeList="http://idec.icc.cat/schema/resources/Codelist/ML_gmxCodelists.
xml#LanguageCode" codeListValue="cat">Catala</gmd:LanguageCode>
    </gmd:language>
    <gmd:topicCategory>
        <gmd:MD_TopicCategoryCode>imageryBaseMapsEarthCover</gmd:MD_TopicCate
goryCode>
    </gmd:topicCategory>
</gmd:extent>
<gmd:EX_Extent>
    <gmd:geographicElement>
        <gmd:EX_GeographicBoundingBox>
            <gmd:extentTypeCode>
                <gco:Boolean>>true</gco:Boolean>
            </gmd:extentTypeCode>
            <gmd:westBoundLongitude>
                <gco:Decimal>1.06474287929127</gco:Decimal>
            </gmd:westBoundLongitude>
            <gmd:eastBoundLongitude>
                <gco:Decimal>1.16161798316134</gco:Decimal>
            </gmd:eastBoundLongitude>
            <gmd:southBoundLatitude>
                <gco:Decimal>41.240141115081</gco:Decimal>
            </gmd:southBoundLatitude>
            <gmd:northBoundLatitude>
                <gco:Decimal>41.3113229349326</gco:Decimal>
            </gmd:northBoundLatitude>
        </gmd:EX_GeographicBoundingBox>
    </gmd:geographicElement>
</gmd:EX_Extent>
</gmd:extent>
</gmd:MD_DataIdentification>
</gmd:identificationInfo>
</gmd:MD_Metadata>
</gmljp2:isoMetadata>
</gmljp2:Metadata>
</gmlcov:metadata>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

## D.2. Earth Observation profile example

NB: It should be noted that EOP schema uses URN instead of URL.

```
<?xml version="1.0" encoding="UTF-8"?>
<gmljp2:GMLJP2CoverageCollection gml:id="JPEG2000_0"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
http://schemas.opengis.net/gmljp2/2.0/gmlJP2.xsd"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0"
xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>
      <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="ID_1">
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="rg0001_C0002" dimension="2"
srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>0 0</gml:low>
              <gml:high>6208 3103</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisName>x</gml:axisName>
          <gml:axisName>y</gml:axisName>
          <gml:origin>
            <gml:Point gml:id="P0001">
              <gml:pos>41.4756576954751 2.04345415526392</gml:pos>
            </gml:Point>
          </gml:origin>
          <gml:offsetVector>0 3.7163372079825e-005</gml:offsetVector>
          <gml:offsetVector>-3.71633720798261e-005 0</gml:offsetVector>
        </gml:RectifiedGrid>
      </gml:domainSet>
      <gml:rangeSet>
        <gml:File>
          <gml:rangeParameters/>
          <gml:fileName>gmljp2://codestream/0</gml:fileName>
          <gml:fileStructure>inapplicable</gml:fileStructure>
        </gml:File>
      </gml:rangeSet>
    </gmljp2:GMLJP2RectifiedGridCoverage>
  </gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>
```

```

</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>   <gmlcov:metadata>
  <gmljp2:Metadata>
    <gmljp2:eopMetadata>
      <eop:EarthObservation
        xmlns:xlink="http://www.w3.org/1999/xlink"
        xmlns:eop="http://www.opengis.net/eop/2.0"
        xmlns:opt="http://www.opengis.net/opt/2.0"
        xmlns:ows="http://www.opengis.net/ows/2.0"
        xmlns:swe="http://www.opengis.net/swe/1.0"
        xmlns:om="http://www.opengis.net/om/2.0"
gml:id="opt_example_1">
      <om:phenomenonTime>
        <gml:TimePeriod gml:id="tp_2">
          <gml:beginPosition>2001-08-
22T11:02:47.000</gml:beginPosition>
          <gml:endPosition>2001-08-22T11:02:47.999</gml:endPosition>
        </gml:TimePeriod>
        </om:phenomenonTime>
        <om:resultTime>
          <!-- repeat of archiving date? -->
          <gml:TimeInstant gml:id="archivingdate_1">
            <gml:timePosition>2001-08-
22T11:02:47.999</gml:timePosition>
          </gml:TimeInstant>
        </om:resultTime>
        <om:procedure>
          <eop:EarthObservationEquipment gml:id="eop_2">
            <eop:platform>
              <eop:Platform>
                <eop:shortName>PHR</eop:shortName>
                <eop:serialIdentifier>1A</eop:serialIdentifier>
              </eop:Platform>
            </eop:platform>
            <eop:instrument>
              <eop:Instrument>
                <eop:shortName>PHR</eop:shortName>
              </eop:Instrument>
            </eop:instrument>
            <eop:sensor>
              <eop:Sensor>
                <eop:sensorType>OPTICAL</eop:sensorType>
                <eop:operationalMode
codeSpace="urn:eop:PHR:sensorMode">PX</eop:operationalMode>
                <eop:resolution uom="m">0.7</eop:resolution>

```

```

        </eop:Sensor>
      </eop:sensor>
      <eop:acquisitionParameters>
        <eop:Acquisition>
          <eop:orbitNumber>12</eop:orbitNumber>
          <eop:lastOrbitNumber>12</eop:lastOrbitNumber>
          <eop:orbitDirection>ASCENDING</eop:orbitDirection>
          <eop:illuminationAzimuthAngle
uom="deg">10</eop:illuminationAzimuthAngle>
          <eop:acrossTrackIncidenceAngle
uom="deg">14.0</eop:acrossTrackIncidenceAngle>
          <eop:alongTrackIncidenceAngle
uom="deg">13.9</eop:alongTrackIncidenceAngle>
          <eop:pitch uom="deg">0</eop:pitch>
          <eop:roll uom="deg">0</eop:roll>
          <eop:yaw uom="deg">0</eop:yaw>
        </eop:Acquisition>
      </eop:acquisitionParameters>
    </eop:EarthObservationEquipment>
  </om:procedure>
  <om:observedProperty xlink:href="#params1"/>
  <om:featureOfInterest>
    <eop:Footprint gml:id="fp_2">
      <eop:multiExtentOf>
        <gml:MultiSurface gml:id="ms_2" srsName="urn:EPSG:4326">
          <gml:surfaceMembers>
            <gml:Polygon gml:id="fppoly_2">
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList>2.1025 43.516667 2.861667 43.381667
2.65
                  42.862778 1.896944 42.996389 2.1025 43.516667
                </gml:posList>
              </gml:LinearRing>
            </gml:exterior>
          </gml:Polygon>
        </gml:surfaceMembers>
      </gml:MultiSurface>
    </eop:multiExtentOf>
    <eop:centerOf>
      <gml:Point gml:id="pt_2" srsName="urn:EPSG::4326">
        <gml:pos>2.374167 43.190833</gml:pos>
      </gml:Point>
    </eop:centerOf>
  </eop:Footprint>
</om:featureOfInterest>
<om:result>
  <opt:EarthObservationResult gml:id="eor_2">
    <eop:mask>
      <eop:MaskInformation>
        <eop:type>CLOUD</eop:type>
        <eop:format>VECTOR</eop:format>
        <eop:fileName>
          <ows:ServiceReference

```

```

xmlns="http://www.opengis.net/ows/2.0"
xlink:href="http://www.mybrowse.com/et"><ows:RequestMessage></ows:RequestMessage></ows:ServiceReference>
    </eop:fileName>
    </eop:MaskInformation>
    </eop:mask>
    <opt:cloudCoverPercentage
uom="%">30</opt:cloudCoverPercentage>
    </opt:EarthObservationResult>
</om:result>
<eop:metaDataProperty>
    <eop:EarthObservationMetaData>
        <eop:identifier>E123N45_0101_01234</eop:identifier>
        <eop:acquisitionType>NOMINAL</eop:acquisitionType>
        <eop:productType>TBD</eop:productType>
        <eop:status>ACQUIRED</eop:status>
        <eop:downlinkedTo>
            <eop:DownlinkInformation>
                <eop:acquisitionStation
codeSpace="urn:eop:PHR:stationCode"
                >TLS</eop:acquisitionStation>
            </eop:DownlinkInformation>
        </eop:downlinkedTo>
        <eop:archivedIn>
            <eop:ArchivingInformation>
                <eop:archivingCenter codeSpace="urn:eop:PHR:stationCode"
                >TLS</eop:archivingCenter>
                <eop:archivingDate>2001-08-
22T11:02:47.999</eop:archivingDate>
            </eop:ArchivingInformation>
        </eop:archivedIn>
        <eop:imageQualityDegradation
uom="%">0</eop:imageQualityDegradation>
        <eop:processing>
            <eop:ProcessingInformation/>
        </eop:processing>
    </eop:EarthObservationMetaData>
</eop:metaDataProperty>
</eop:EarthObservation>
</gmljp2:eopMetadata>
</gmljp2:Metadata>
</gmlcov:metadata>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

### D.3. Dublin Core metadata example

```

<?xml version="1.0" encoding="UTF-8"?>
<gmljp2:GMLJP2CoverageCollection gml:id="JPEG2000_0"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
http://schemas.opengis.net/gmljp2/2.0/gmlJP2.xsd"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0"

```

```

xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>

    <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
  <gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Collection"> </swe:field>
    </swe:DataRecord>
  </gmlcov:rangeType>
  <gmljp2:featureMember>
    <gmljp2:GMLJP2RectifiedGridCoverage gml:id="ID_1">
      <gml:domainSet>
        <gml:RectifiedGrid gml:id="rg0001_C0002" dimension="2"
srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>0 0</gml:low>
              <gml:high>6208 3103</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisName>x</gml:axisName>
          <gml:axisName>y</gml:axisName>
          <gml:origin>
            <gml:Point gml:id="P0001">
              <gml:pos>41.4756576954751 2.04345415526392</gml:pos>
            </gml:Point>
          </gml:origin>
          <gml:offsetVector>0 3.7163372079825e-005</gml:offsetVector>
          <gml:offsetVector>-3.71633720798261e-005 0</gml:offsetVector>
        </gml:RectifiedGrid>
      </gml:domainSet>
      <gml:rangeSet>
        <gml:File>
          <gml:rangeParameters/>
          <gml:fileName>gmljp2://codestream/0</gml:fileName>
          <gml:fileStructure>inapplicable</gml:fileStructure>
        </gml:File>
      </gml:rangeSet>
    </gmlcov:rangeType>
    <swe:DataRecord>
      <swe:field name="Panchromatic">
        <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
          <swe:description>Panchromatic Channel</swe:description>
          <swe:uom code="unity"/>
          <!-- Unity for value without unit of measures -->
        </swe:Quantity>
      </swe:field>
    </swe:DataRecord>
  </gmljp2:featureMember>
</gml:rangeSet>
</gmlcov:rangeType>
</gmljp2:featureMember>
</gml:doubleOrNilReasonTupleList>
</gml:DataBlock>
</gml:rangeSet>
</gmlcov:rangeType>
</gmljp2:featureMember>
</gml:domainSet>
</gml:RectifiedGrid>
</gml:limits>
</gml:GridEnvelope>
</gml:high>
</gml:low>
</gml:RectifiedGrid>
</gml:offsetVector>
</gml:offsetVector>
</gml:Point>
</gml:pos>
</gml:origin>
</gml:axisName>
</gml:axisName>
</gml:limits>
</gml:RectifiedGrid>
</gml:domainSet>
</gml:rangeSet>
</gml:File>
</gml:fileStructure>
</gml:fileName>
</gml:rangeParameters/>
</gml:File>
</gml:rangeSet>
</gmlcov:rangeType>
</swe:DataRecord>
</swe:field name="Panchromatic">
</swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
</swe:description>
</swe:uom code="unity"/>
<!-- Unity for value without unit of measures -->
</swe:Quantity>

```

```

    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>    <gmlcov:metadata>
  <gmljp2:Metadata>
    <gmljp2:dcMetadata
xsi:schemaLocation="http://purl.org/dc/elements/1.1/
http://schemas.opengis.net/csw/2.0.2/rec-dcmes.xsd">
      <dc:title>Features that are common to all
codestreams</dc:title>
      <dc:publisher>ogc</dc:publisher>
    </gmljp2:dcMetadata>
  </gmljp2:Metadata>
</gmlcov:metadata>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```

#### D.4. Free text metadata example

```

<gmljp2:GMLJP2CoverageCollection gml:id="JPEG2000_0"
xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
http://schemas.opengis.net/gmljp2/2.0/gmlJP2.xsd"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0"
xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<gml:domainSet nilReason="inapplicable"/>
  <gml:rangeSet>
    <gml:DataBlock>
      <gml:rangeParameters nilReason="inapplicable"/>

      <gml:doubleOrNilReasonTupleList>inapplicable</gml:doubleOrNilReasonTup
leList>
    </gml:DataBlock>
  </gml:rangeSet>
</gmlcov:rangeType>
<gmljp2:featureMember>
  <gmljp2:GMLJP2RectifiedGridCoverage gml:id="ID_1">
    <gml:domainSet>
      <gml:RectifiedGrid gml:id="rg0001_C0002" dimension="2"
srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
        <gml:limits>
          <gml:GridEnvelope>
            <gml:low>0 0</gml:low>
            <gml:high>6208 3103</gml:high>
          </gml:GridEnvelope>
        </gml:limits>
        <gml:axisName>x</gml:axisName>
        <gml:axisName>y</gml:axisName>

```

```

    <gml:origin>
      <gml:Point gml:id="P0001">
        <gml:pos>41.4756576954751 2.04345415526392</gml:pos>
      </gml:Point>
    </gml:origin>
    <gml:offsetVector>0 3.7163372079825e-005</gml:offsetVector>
    <gml:offsetVector>-3.71633720798261e-005 0</gml:offsetVector>
  </gml:RectifiedGrid>
</gml:domainSet>
<gml:rangeSet>
  <gml:File>
    <gml:rangeParameters/>
    <gml:fileName>gmljp2://codestream/0</gml:fileName>
    <gml:fileStructure>inapplicable</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Panchromatic">
      <swe:Quantity definition="http://www.opengis.net/def/ogc-
eo/opt/SpectralMode/PANCHROMATIC">
        <swe:description>Panchromatic Channel</swe:description>
        <swe:uom code="unity"/>
        <!-- Unity for value without unit of measures -->
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType> <gmlcov:metadata>
  <gmljp2:Metadata>
    <gmljp2:metadata>Some simple textual metadata</gmljp2:metadata>
  </gmljp2:Metadata>
</gmlcov:metadata>
</gmljp2:GMLJP2RectifiedGridCoverage>
</gmljp2:featureMember>
</gmljp2:GMLJP2CoverageCollection>

```



## **Annex E Bibliography**

- [1] ISO 19139, Geographic Information – Metadata – XML schema implementation.
- [2] OGC 12-083 GMLJP2 Extensions

### Annex F Revision History

Date	Release	Editor	Primary clauses modified	Description
25 July 2004	0.0.1	Ron Lake	All	Initial document, formatted for OGC template
10 August 2004	0.1.0	David Burggraf	All	Added content to clauses in Sections 7 and 8; reviewed and made minor modifications to all other clauses.
18 May 2005	0.2.0	Martin Kyle	All	Upgrade based on results to date of Interoperability Experiment
19 May 2005	0.2.1	David Burggraf	7, 8, Annexes A-D	Updates made to address discussion points in GMLJP2 Interoperability Experiment
19 May 2005	0.2.2	Martin Kyle	All	Formatting Changes based on OGC endorsed ISO spec format
20 May 2005	0.2.3	Sean Forde	All	Incorporation of gmljp2 URI syntax, updated label names, added comments
23 May 2005	0.2.4	David Burggraf	7, 8, Annexes A-D	Updated sample schemas and instances
23 May 2005	0.2.5	Martin Kyle	All	Final review, clean up, and remaining issues
23 May 2005	0.2.6	Sean Forde	8.0	Small formatting and syntax changes; modified wording in clause 8.0; removed incorrect abbreviations for JP2 box types; added missing box type labels to box graphics
23 May 2005	0.2.7	Sean Forde	3, 6.6, 6.7, 7.5, 7.6	Added requirement to comply with OGC document 05-010 for URN references to CRS and UOM when referring to such entities by reference
23 May 2005	0.2.8	Martin Kyle	7.6; 8.0	Small abbreviation fixes and grammatical fixes
21 June 2005	0.2.9	Sean Forde	3, 7.5, 8.2, A.1	Added reference to OGC doc 05-011 for CRS definitions; corrected box diagram
22 June 2005	0.2.10	Arliss Whiteside	All	Formatting and miscellaneous comments
26 June 2005	0.3.0	Martin Kyle	All	Add future work items, merge comments from 0.2.9, proof for RFC

Date	Release	Editor	Primary clauses modified	Description
25 November 2005	1.0.0	Martin Kyle	All	Updates based on friendly amendments from GML WG at November TC in Bonn, Germany and recommendations for profile standardization. Prep for R1 vote and release
28 November 2005	1.0.0	Carl Reed	All	Grammatical and informative edits
29 November 2005	1.0.0	Martin Kyle	All	Final proof
20 December 2005	1.0.0	Martin Kyle	Annex A, C, D	Update location of xlink.xsd using authoritative relative reference at OGC schema repository
6 Oct 2008	1.1.0	Michael P. Gerlek	All	Updated to new OGC template; redrew all figures and tables; extensive editorial revisions; significant syntactic and semantic corrections throughout; changed requirement of "GML coverage / rectified grid" to be more loosely defined; added nil value commentary
04 Oct 2010	2.0.0	David Burggraf	All	General review and edits
18 Jul 2012	2.0.1	Lucio Colaiacomo,..	All	General review and edits
23 Jan 2013	2.0.2	Lucio Colaiacomo, Joan Masó.	All	General review and edits. Requirements specified
06 May 2013	2.0.3	SWG	All	General Review
20 July 2013	2.0.4	Joan Masó.	All	General review and cleaning
20 Sep 2013	2.0.5-7	Joan Masó, Emmanuel Devys, Lucio Colaiacomo	All	General review and cleaning. Review of the schemas.
10 Oct 2013	2.0.8	Emmanuel Devys	Annex B	UML models included

Date	Release	Editor	Primary clauses modified	Description
12 Dec 2013	2.0.9	Joan Maso, Emmanuel Devys, Lucio Colaiacomo	All	General revision with modification requested by OGC Architecture Board
17 April 2014	2.0.10	Joan Maso, Emmanuel Devys, Lucio Colaiacomo	All	General revision for resolution of RFC comments
04 Nov 2015	2.0.11	Lucio Colaiacomo, Raul Alonso Reyes, Emmanuel Devys	All	Corrigendum