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GML in JPEG 2000 for Geographic Imagery

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i. Preface

ii. Submitting organizations

The following organizations submitted this Implementation Specification to the Open GIS Consortium Inc. as a Request For Comment (RFC) / in response to the OGC Request For Proposal (RFP) XX:

- a) Galdos Systems Inc.
- b) Lizard Tech

iii. Submission contact points

All questions regarding this submission should be directed to the editor or the submitters:

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iv. Revision history

Date	Release	Author	Paragraph modified	Description

v. Changes to the OpenGIS[®] Abstract Specification

The OpenGIS[®] Abstract Specification **requires/does not require** changes to accommodate this OpenGIS[®] standard. **The needed changes are proposed in OGC documents XX-XXX, XX-XXX, and XX-XXX. / The following is a list of the required changes:**

Foreword

Introduction

GML (Geography Markup Language) 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.

JPEG 2000 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 package.

This specification defines the means by which GML is to be used within JPEG 2000 images for geographic imagery. This includes the following:

- Specification of the uses of GML within JPEG 2000 data packages.
- Packaging mechanisms for including GML within JPEG 2000 data packages.
- **Specific GML application schemas to support the encoding of OGC coverages within JPEG 2000 data packages.**

Implementation Specification – GML in JPEG 2000

1 Scope

2 Conformance

3 Normative references

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply /the terms and definitions given in ... and the following apply.

4.1

term name

text of the definition

4.2

term name

synonym

text of the definition

5 Conventions

5.1 Symbols (and abbreviated terms)

5.2 UML Notation

The diagrams that appear in this standard are presented using the Unified Modeling Language (UML) static structure diagram. The UML notations used in this standard are described in the diagram below.

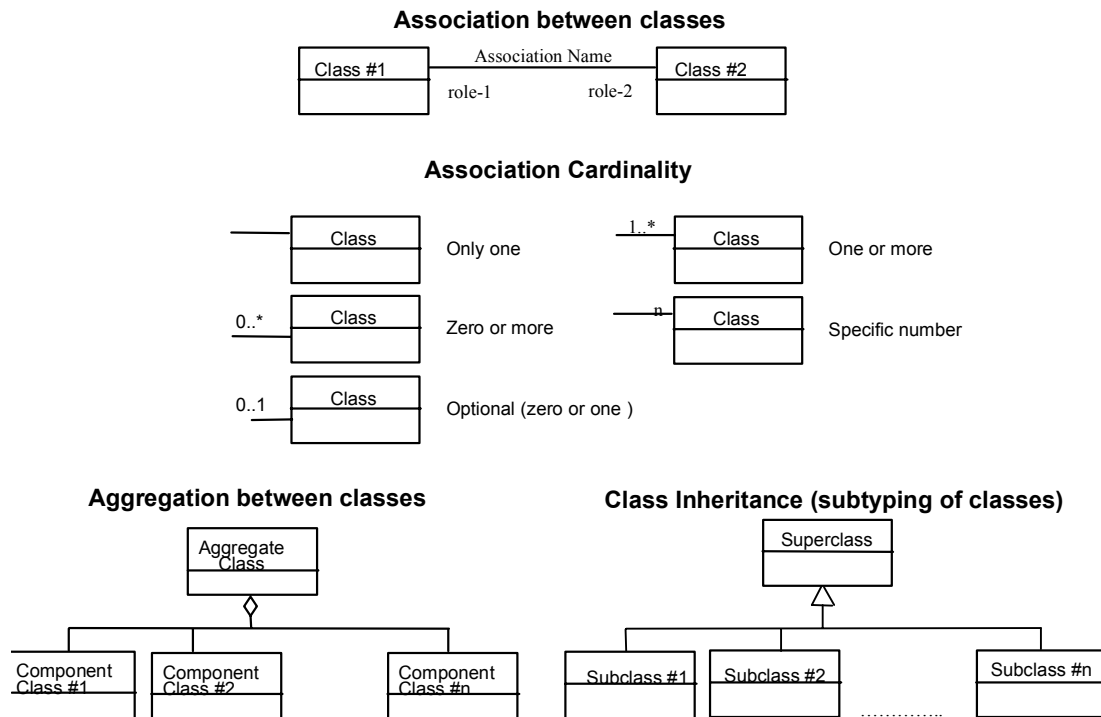


Figure 1 — UML notation

In this standard, the following three stereotypes of UML classes are used:

- a) <<Interface>> A definition of a set of operations that is supported by objects having this interface. An Interface class cannot contain any attributes.
- b) <<DataType>> A descriptor of a set of values that lack identity (independent existence and the possibility of side effects). A DataType is a class with no operations whose primary purpose is to hold the information.
- c) <<CodeList>> is a flexible enumeration that uses string values for expressing a list of potential values.

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

- a) CharacterString – A sequence of characters
- b) Integer – An integer number
- c) Double – A double precision floating point number
- d) Float – A single precision floating point number

6 Roles of GML in JPEG 2000 for Geographic Imagery

This section describes the roles of 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 described in Clause 7 must be followed.

The primary role of GML in relation to JPEG 2000 is to make the latter into a geographic image. This is accomplished by providing in GML the description of the image geometry and radiometry. In addition, GML data can be used, as described in this clause, for the encoding of coverage metadata, geographic features, annotations, annotation and feature styling, and supporting components for coordinate reference systems and unit of measure definitions.

6.1 Coverage Encoding

Coverage information within a JPEG 2000 image makes the associated JPEG 2000 file into a coverage or geographic image. Such coverage information is to be encoded in GML per Clause 7.1. Coverage information includes the following:

- Description of the coverage geometry. In most cases this will be a gml:Grid or gml:RectifiedGrid, but could be any other GML aggregation geometry type (e.g. MultiPoint).
- Description of the value side (or range) of the coverage. This corresponds to the radiometry in image terms. Note that a GML-JPEG 2000 geographic “image” could include Digital Elevation Models, Bathymetry data etc. Description of the range of the coverage may employ units of measure.
- Description of the mapping of the geometry to the values stored in the JPEG codestream.

GML in JPEG 2000 is intended to handle a variety of imaging use cases including the following:

- Single non-geo-referenced images. GML describes the “geometry” and the radiometry.
- Single geo-referenced images. GML describes the geometry and the radiometry.
- Multiple geo-referenced images of the same type. GML describes the geometry and the radiometry of the constituent images. Examples include a stereo photographic pair and a triangulation block of images.
- Multiple geo-reference images of various types. GML describes the geometry and the radiometry of the constituent images. Examples include combinations of images such an optical image, FLIR and SAR images for target identification.

- Ortho-rectified images with or without associated digital elevation models.
- Digital Elevation Models that incorporate terrain-based constraints.

Coverage descriptions may require an associated GML application schema. Mechanisms for referencing and/or transporting GML application schemas are discussed in Clause 8.

6.2 Coverage Metadata

Clause 6.1 describes the role of GML in conjunction with JPEG 2000 to create geographic images. This section describes the use of GML to encode metadata about such geographic images. This approach takes a hierarchical view of metadata as shown in Figure 6.2-1.

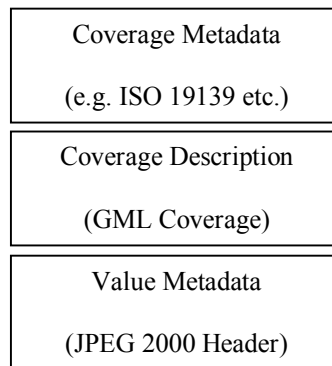


Figure 6-1 Metadata Hierarchy

GML provides a metadata property (`gml:metaDataProperty`) which can be attached to any GML object including of course a GML coverage. This 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. Note that this can be used to support custom, user-defined metadata schemas or international standards such as ISO 19139. Where ISO 19139 is used, the coverage information described in GML (GML coverage description) takes precedence over any geometry or radiometric information provided in the ISO 19139 metadata schema. If such information is provided in the metadata schema it is the responsibility of the data provider to ensure that it is consistent with the coverage descriptions provided in GML.

6.3 Image Annotation

A specific GML application schema is provided for expressing annotations (see Clause 7.3 and 9.). Annotations provide an association between geometric “regions” (0d, 1d, 2d etc.) in an image and annotation text, imagery, video and feature references. Annotations are intended to be styled for visual presentation. An Annotation can be thought of as drawing attention to some “region” of an image.

User defined application schemas are not required for image annotation.

6.4 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 package or may be independent of the image altogether.

Geographic features must be encoded as GML features and comply with the rules for GML Application Schemas as defined Clause X of the GML v... Encoding of features requires an associated GML application schema. Mechanisms for referencing and/or transporting GML application schemas are discussed in Clause 8.

6.5 Feature and Annotation Styling

Geographic features in GML express geographic content. Visual presentation of such geographic features and annotations requires an external styling mechanism to interpret and transform the GML features and annotations into graphical objects (e.g. SVG). Styling rules can be expressed using one of the following:

- OGC Styled Layer Descriptors (SVG Target)
- GML Default Styling (SVG Target)
- XSLT Scripts (SVG Target)

6.6 Coordinate Reference Systems

Coverage geometries and the geometric properties of GML features and annotations include coordinates which are interpreted by reference to a coordinate reference system. GML provides a grammar for the encoding of 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 8.

6.7 Units of Measure

Coverage values and properties of GML features and annotations may employ references to units of measure. 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.

Some units of measure may require use of a GML units of measure application schema. Mechanisms for referencing and/or transporting GML application schemas are discussed in Clause 8.

7 Encoding Rules for GML in JPEG 2000

This section describes specific rules that **MUST** be followed when encoding GML data for use within JPEG 2000 files.

All GML instance data associated with a codestream is contained in a single GML FeatureCollection (gml:FeatureCollection). Supporting GML data (e.g. dictionary definitions) are located in a Dictionary instance box and must not be contained in the FeatureCollection. The FeatureCollection members can consist of:

1. GML Coverage objects (ONE only).
2. GML Features (zero or more).
3. GML annotations (zero or more, see Clause 9.)

These may appear in any order in the FeatureCollection (i.e. there is no requirement that the coverage object be first).

GML metadata is referenced through the gml:metadataProperty which is attached to one or more of the objects as above.

GML default styles are referenced through the gml:defaultStyle property which is attached to one or more of the objects as above.

The boundedBy property of the FeatureCollection must contain a value which reflects the geographic extent of an Envelope that bounds all of the features within the FeatureCollection.

Instance data for units of measure and coordinate reference system definitions may be optionally provided. This must be contained in a Dictionary file which **MUST** be valid against the GML dictionary.xsd.

7.1 Coverage Description

GML Coverage Descriptions define the associated JPEG 2000 file as a geographic image. Such coverage descriptions are based directly on the GML coverage.xsd or through the use of a GML application schema that imports (directly or indirectly) coverage.xsd. There can be only ONE coverage description instance per codestream, and only ONE coverage description per FeatureCollection. Clause 8.2 provides details on the mapping of coverage description instances and codestreams in the multiple codestream case.

The following is an example coverage description:

```
<expl:AverageTemp dimension="2" gml:id="AT0001">
  <gml:rectifiedGridDomain>
    <gml:RectifiedGrid dimension="2">
      <gml:limits>
```

```

    <gml:GridEnvelope>
      <gml:low>1 1</gml:low>
      <gml:high>4 4</gml:high>
    </gml:GridEnvelope>
  </gml:limits>
  <gml:axisName>u</gml:axisName>
  <gml:axisName>v</gml:axisName>
  <gml:origin>
    <gml:Point gml:id="P0001" srsName="urn:jp2k:xml:crs:crs1123">
      <gml:coordinates>1.2 3.4</gml:coordinates>
    </gml:Point>
  </gml:origin>
  <gml:offsetVector srsName="urn:jp2k:xml:crs:crs1123">1 2</gml:offsetVector>
  <gml:offsetVector srsName="urn:jp2k:xml:crs:crs1123">4 5</gml:offsetVector>
</gml:RectifiedGrid>
</gml:rectifiedGridDomain>
<gml:rangeSet>
  <gml:File>
    <gml:rangeParameters>
      <exp1:Temperature uom="urn:jp2k:xml:uom:degC">template</exp1:Temperature>
    </gml:rangeParameters>
    <gml:fileName>file123.jp2</gml:fileName>
    <gml:fileStructure>Record Interleaved</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
</exp1:AverageTemp>

```

This example states that the image is a Temperature coverage on a rectified grid with the temperature expressed in degrees centigrade.

7.2 Coverage Metadata

Metadata about the GMLJP2K coverage is handled using the `gml:metaDataProperty`. This property must point to (i.e. via `xlink:href`) or include in-line the various metadata properties and their values. This will require the use of an external schema to define the metadata properties. This can be user defined or conform to an international standard such as ISO 19139. An example of such a metadata schema is as follows:

```

<xs:schema targetNamespace="http://www.ukusa.org"
  xmlns:gml="http://www.opengis.net/gml"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:abc="http://www.ukusa.org" elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:import namespace="http://www.opengis.net/gml"
  schemaLocation="C:\Galdos\examples\project\gml3normative\gml3normative\base\gmlBase.xsd"/>
  <xs:element name="Info" substitutionGroup="gml:_MetaData">
    <xs:annotation>
      <xs:documentation>Comment describing your root element</xs:documentation>
    </xs:annotation>
    <xs:complexType>
      <xs:complexContent>
        <xs:extension base="gml:AbstractMetaDataType">
          <xs:sequence>
            <xs:element name="createdOn" type="xs:dateTime"/>
            <xs:element name="createdBy" type="xs:string"/>
          </xs:sequence>
        </xs:extension>
      </xs:complexContent>
    </xs:complexType>
  </xs:element>

```



```

        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
</xs:element>
</xs:schema>

```

Note that to use this schema is MUST be referenced by the feature instance as shown below:

```

<?xml version="1.0" encoding="UTF-8"?>
<gml:FeatureCollection xmlns="http://www.opengis.org/schema/gml-jp2"
  xmlns:gml="http://www.opengis.net/gml"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:abc="http://www.ukusa.org"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:exp1="http://www.spain.org" xmlns:exp2="http://www.france.org"
  xsi:schemaLocation="http://www.ukusa.org Mymetadata.xsd
    http://www.opengis.net/gml ../gml3.0/base/gml.xsd
    http://www.spain.org CoverageSchema.xsd
    http://www.france.org FeatureSchema.xsd">
  <gml:metaDataProperty>
    <abc:Info>
      <abc:createdOn>2000-03-04T20:00:00Z</abc:createdOn>
      <abc:createdBy>John Smith</abc:createdBy>
    </abc:Info>
  </gml:metaDataProperty>
  <gml:description>This GML/JPEG 2000 Root Instance contains a GML coverage description and
  GML feature descriptions of the geographic features embedded in the image</gml:description>
  <gml:name>Root Instance</gml:name>
  <gml:boundedBy>
    <gml:Null>missing</gml:Null>
  </gml:boundedBy>
  <gml:featureMembers>
    <exp1:AverageTemp dimension="2" gml:id="AT0001">
      <gml:rectifiedGridDomain>
        <gml:RectifiedGrid dimension="2">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>1 1</gml:low>
              <gml:high>4 4</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisName>u</gml:axisName>
          <gml:axisName>v</gml:axisName>
          <gml:origin>
            <gml:Point gml:id="P0001" srsName="urn:jp2k:xml:crs:crs1123">
              <gml:coordinates>1.2 3.4</gml:coordinates>
            </gml:Point>
          </gml:origin>
          <gml:offsetVector srsName="urn:jp2k:xml:crs:crs1123">1 2</gml:offsetVector>
          <gml:offsetVector srsName="urn:jp2k:xml:crs:crs1123">4 5</gml:offsetVector>
        </gml:RectifiedGrid>
      </gml:rectifiedGridDomain>
      <gml:rangeSet>
        <gml:File>

```

```

    <gml:rangeParameters>
      <exp1:Temperature uom="urn:jp2k:xml:uom:degC">template</exp1:Temperature>
    </gml:rangeParameters>
    <gml:fileName>file123.jp2</gml:fileName>
    <gml:fileStructure>Record Interleaved</gml:fileStructure>
  </gml:File>
</gml:rangeSet>
</exp1:AverageTemp>
...
</gml:featureMembers>
<gml:FeatureCollection>

```

Note that this above example is encoded as it might appear prior to inclusion in the JPEG 2000 file. When included in the JPEG 2000 file all schema location references MUST be encoded as URN (see Clause 8.) hence the header section of this instance file would appear as:

```

<?xml version="1.0" encoding="UTF-8"?>
<gml:FeatureCollection xmlns="http://www.opengis.org/schema/gml-jp2"
  xmlns:gml="http://www.opengis.net/gml"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:abc="http://www.ukusa.org"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:exp1="http://www.spain.org" xmlns:exp2="http://www.france.org"
  xsi:schemaLocation="http://www.ukusa.org urn:jp2k:schema01::"
    http://www.opengis.net/gml http://www.ukusa.org urn:jp2k:schema02::
    http://www.spain.org urn:jp2k:schema03::
    http://www.france.org urn:jp2k:schema04::">
...
<gml:FeatureCollection>

```

Since, in this case, all of the schemas are encoded within the JPEG 2000 file, the decoder would expect to find schema files in each of the boxes with labels schema01, schema02, schema03 and schema04. Note that label text is arbitrary and is constrained only by the syntactical restrictions of the URN (RFC 2141, IETF) and of the label box in JPEG2000 Part II (JPX).

7.3 Minimal Instance

The GML Data must at the minimum consist of a GML Coverage. The simplest RectifiedGridCoverage example given below does little more than use the coverage domain to georectify the image.

```

<gml:FeatureCollection>
  <gml:boundedBy>
    <gml:Null>withheld</gml:Null>
  </gml:boundedBy>
  <gml:featureMember>
    <gml:RectifiedGridCoverage dimension="2" gml:id="RGC0001">
      <gml:rectifiedGridDomain>
        <gml:RectifiedGrid dimension="2">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>1 1</gml:low>
              <gml:high>4 4</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
        </gml:RectifiedGrid>
      </gml:rectifiedGridDomain>
    </gml:RectifiedGridCoverage>
  </gml:featureMember>
</gml:FeatureCollection>

```

```

        </gml:GridEnvelope>
    </gml:limits>
    <gml:axisName>u</gml:axisName>
    <gml:axisName>v</gml:axisName>
    <gml:origin>
        <gml:Point gml:id="P0001" srsName="urn:jp2k:label002:xml:crs:c1123">
            <gml:coordinates>1.2 3.4</gml:coordinates>
        </gml:Point>
    </gml:origin>
    <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">1 2</gml:offsetVector>
    <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">4 5</gml:offsetVector>
</gml:RectifiedGrid>
</gml:rectifiedGridDomain>
<gml:rangeSet>
    <gml:File>
        <gml:rangeParameters>
            <gml:QuantityList uom="urn:jp2k:labelID:xml:uom:code">inapplicable</gml:QuantityList>
        </gml:rangeParameters>
        <gml:fileName>file123.jp2</gml:fileName>
        <gml:fileStructure>Record Interleaved</gml:fileStructure>
    </gml:File>
</gml:rangeSet>
</gml:RectifiedGridCoverage>
</gml:featureMember>
</gml:FeatureCollection>

```

Note that the *QuantityList* value of *RangeParameters* is set to "inapplicable" and hence the *rangeSet* describes its range parameters in only a generic way.

7.4 Image Annotation

An annotation is an association between an annotation entity (e.g. a text label or another image) and an image or some geometric “region” within the image. The geometric region is defined by a GML geometry, which can be a point, linestring etc. If no geometric region is defined the annotation applies to the entire image (i.e. JPEG 2000 codestream).

A sample *Annotation* with an association to a geometric region has the form:

```

<Annotation gml:id="AN001">
    <pointer>...</pointer>
    <content>...</content>
    <annotates>
        <gml:Polygon gml:id="PI001" srsName="urn:jp2k:label:xml:crs:id">
            <gml:exterior>
                <gml:LinearRing>
                    <gml:pos>22 44</gml:pos>
                    <gml:pos>55 77</gml:pos>
                    <gml:pos>88 100</gml:pos>
                    <gml:pos>22 44</gml:pos>
                </gml:LinearRing>
            </gml:exterior>
        </gml:Polygon>
    </annotates>
</Annotation>

```

```

    </gml:Polygon>
  </annotates>
</Annotation>

```

The *pointer* property value is a *gml:Curve*, which is meant to be styled by an arrow or line symbol and is used to visually represent the annotation association. The *content* property value can be either a *Label* or an *Image*, which are each annotation entities (c.f. clause 7.4). The *annotates* property value is a geometry (*Polygon* in example above) that represents a region within the image and is the target of the annotation. Note that the *srsName* attribute on the above *Polygon* specifies the Coordinate Reference System (CRS), which will often be the Image CRS. The *srsName* value shown above is in a URN format used to reference resources located within the JPEG2000 file (see Clause 8.5). The corresponding schema definition for the instance fragment above is as follows:

```

<element name="Annotation" type="xima:AnnotationType"/>

<complexType name="AnnotationType">
  <complexContent>
    <extension base="xima:AnnotationBaseType">
      <sequence>
        <element name="pointer" type="gml:CurvePropertyType" minOccurs="0"
          maxOccurs="unbounded"/>
        <element ref="xima:content"/>
        <element name="annotates" type="gml:GeometryPropertyType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>

<element name="content">
  <complexType>
    <sequence>
      <element ref="xima:_AnnotationBase" maxOccurs="unbounded"/>
    </sequence>
  </complexType>
</element>

```

Annotation meta data can be added using the *gml:metaDataProperty* to describe the author, data of creation, and certainty (with corresponding rationale for the certainty) of the data. A *PointOfInterest* is a specialized type of *Annotation* that defines a relationship between an annotation entity and a *gml:Point* in an image is given as an example.

```

<PointOfInterest gml:id="POI001">
  <gml:metaDataProperty>
    <AnnotationMetaData>
      <title>Some point of interest</title>
      <author>Author Name</author>
      <dateTime>2004-12-12T01:01:01</dateTime>
      <certainty>medium</certainty>
      <rationale>proximity of point is a close match to that of known building</rationale>
    </AnnotationMetaData>
  </gml:metaDataProperty>

```

```

<pointer>...</pointer>
<content>...</content>
<annotates>
  <gml:Point gml:id="Pt001" srsName="urn:jp2k:label:xml:crs:id">
    <gml:pos>30 30</gml:pos>
  </gml:Point>
</annotates>
</PointOfInterest>

```

Note that the *rationale* property must occur together with the *certainty* property or not at all (which is enforced at the schema level.) The schema fragment for *AnnotationMetaData* is as follows:

```

<element name="AnnotationMetaData" substitutionGroup="gml:_MetaData">
  <complexType mixed="true">
    <complexContent mixed="true">
      <extension base="gml:AbstractMetaDataType">
        <sequence>
          <group ref="xima:properties"/>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

<group name="properties">
  <sequence>
    <element ref="xima:title" minOccurs="0"/>
    <element ref="xima:author" minOccurs="0"/>
    <element ref="xima:dateTime" minOccurs="0"/>
    <sequence minOccurs="0">
      <element ref="xima:certainty"/>
      <element ref="xima:rationale" minOccurs="0"/>
    </sequence>
  </sequence>
</group>

<element name="title" type="string"/>
<element name="author" type="string"/>
<element name="dateTime" type="dateTime"/>
<element name="certainty" type="string"/>
<element name="rationale" type="string"/>

```

The specialized types of *Annotation* defined in *Annotation.xsd* are summarized in the following table:

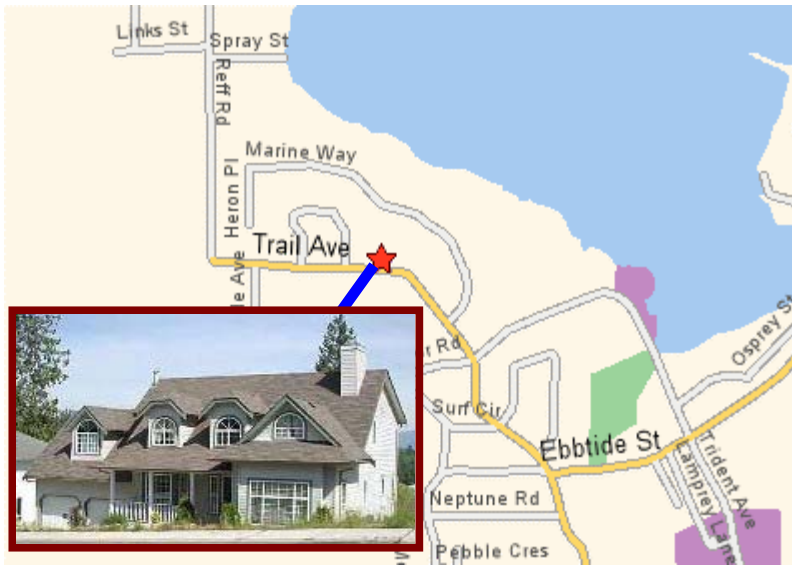
Element Name	Target of annotation association
<i>PointOfInterest</i>	<i>gml:Point</i>
<i>CurveOfInterest</i>	<i>gml:Curve</i>
<i>RegionOfInterest</i>	<i>gml:Polygon</i>
<i>FeatureOfInterest</i>	<i>gml:Feature</i>
<i>Annotation</i>	<i>gml: Geometry</i>

7.4.1 Annotation Entities

An annotation entity is the source of an annotation association that relates this to a geometric target within the image. The annotation entities defined in Annotation.xsd are *Label* and *Image*, which represent a text label and another image, respectively. In the figure below a text label “My House” is the annotation entity.



In the figure below an image (photo of a building) is used as the annotation entity.



7.4.2 Annotation and Feature Styling

The *gml:defaultStyle* property can be used to style the corresponding geometry contained within the *pointer*, *content* and *annotates* properties. Examples of each of these annotation entities are given in the remainder of this clause.

A sample encoding is given for the *PointOfInterest* annotation using a Label annotation entity as follows:

```
<PointOfInterest gml:id="POI001">
  <gml:defaultStyle>
    <!--Style overlays (blue) line symbol on top of Annotation/pointer value-->
    <gml:Style>
      <gml:featureStyle>
        <gml:FeatureStyle featureType="PointOfInterest" queryGrammar="xpath">
          <gml:geometryStyle>
            <gml:GeometryStyle geometryProperty="pointer" geometryType="gml:LineString">
              <gml:style>stroke:blue;stroke-width:5</gml:style>
            </gml:GeometryStyle>
          </gml:geometryStyle>
        </gml:FeatureStyle>
      </gml:featureStyle>
    </gml:Style>
  </gml:defaultStyle>
  <gml:defaultStyle>
    <!--Style overlays point (star) symbol on annotates property value-->
    <gml:Style>
      <gml:featureStyle>
        <gml:FeatureStyle featureType="PointOfInterest" queryGrammar="xpath">
          <gml:geometryStyle>
            <gml:GeometryStyle geometryProperty="annotates" geometryType="gml:Point">
              <gml:symbol symbolType="svg" xlink:href="http://symbology.com/stars.svg#Star01"/>
            </gml:GeometryStyle>
          </gml:geometryStyle>
        </gml:FeatureStyle>
      </gml:featureStyle>
    </gml:Style>
  </gml:defaultStyle>

```

```

        </gml:geometryStyle>
      </gml:FeatureStyle>
    </gml:featureStyle>
  </gml:Style>
</gml:defaultStyle>
<pointer>
  <gml:LineString gml:id="L001">
    <gml:pos>12 34</gml:pos>
    <gml:pos>45 36</gml:pos>
    <gml:pos>78 34</gml:pos>
  </gml:LineString>
</pointer>
<content>
  <Label>
    <gml:defaultStyle>
      <!--Style creates text label-->
      <gml:Style>
        <gml:featureStyle>
          <gml:FeatureStyle featureType="Label" queryGrammar="xpath">
            <gml:labelStyle>
              <gml:LabelStyle>
                <gml:style>font-family:Verdana;font-size:18</gml:style>
                <gml:label>
                  <gml:LabelExpression>./xima:textContent</gml:LabelExpression>
                </gml:label>
              </gml:LabelStyle>
            </gml:LabelStyle>
          </gml:FeatureStyle>
        </gml:featureStyle>
      </gml:Style>
    </gml:defaultStyle>
    <xima:textContent>My House</xima:textContent>
    <xima:anchorPoint>
      <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
        <gml:pos>0 10</gml:pos>
      </gml:Point>
    </xima:anchorPoint>
  </Label>
</content>
<annotates>
  <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
    <gml:pos>30 30</gml:pos>
  </gml:Point>
</annotates>
</PointOfInterest>

```

In the following sample encoding an Image annotation entity is used:

```

<PointOfInterest gml:id="POI002">
  <gml:defaultStyle>
    <!--Style overlays (blue) line symbol on top of Annotation/pointer value-->
    <gml:Style>
      <gml:featureStyle>
        <gml:FeatureStyle featureType="PointOfInterest" queryGrammar="xpath">
          <gml:geometryStyle>
            <gml:GeometryStyle geometryProperty="pointer" geometryType="gml:LineString">
              <gml:style>stroke:blue;stroke-width:5</gml:style>
            </gml:GeometryStyle>
          </gml:geometryStyle>
        </gml:FeatureStyle>
      </gml:featureStyle>
    </gml:Style>
  </gml:defaultStyle>
  <gml:label>
    <gml:LabelExpression>./xima:textContent</gml:LabelExpression>
  </gml:label>
  <xima:anchorPoint>
    <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
      <gml:pos>0 10</gml:pos>
    </gml:Point>
  </xima:anchorPoint>
  <xima:annotates>
    <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
      <gml:pos>30 30</gml:pos>
    </gml:Point>
  </xima:annotates>
</PointOfInterest>

```



```

        </gml:geometryStyle>
      </gml:FeatureStyle>
    </gml:featureStyle>
  </gml:Style>
</gml:defaultStyle>
<gml:defaultStyle>
  <!--Style overlays point (star) symbol on annotates property value-->
  <gml:Style>
    <gml:featureStyle>
      <gml:FeatureStyle featureType="PointOfInterest" queryGrammar="xpath">
        <gml:geometryStyle>
          <gml:GeometryStyle geometryProperty="annotates" geometryType="gml:Point">
            <gml:symbol symbolType="svg" xlink:href="http://symbology.com/stars.svg#Star01"/>
          </gml:GeometryStyle>
        </gml:geometryStyle>
      </gml:FeatureStyle>
    </gml:featureStyle>
  </gml:Style>
</gml:defaultStyle>
<pointer>
  <gml:LineString gml:id="L001">
    <gml:pos>12 34</gml:pos>
    <gml:pos>45 36</gml:pos>
    <gml:pos>78 34</gml:pos>
  </gml:LineString>
</pointer>
<content>
  <Image>
    <gml:defaultStyle>
      <!--Style places image file inside boundary Envelope-->
      <gml:Style>
        <gml:featureStyle>
          <gml:FeatureStyle featureType="Image" queryGrammar="xpath">
            <gml:geometryStyle>
              <gml:GeometryStyle geometryProperty="xima:boundary"
geometryType="gml:Envelope">
                <gml:style>stroke:maroon;stroke-width:5</gml:style>
              </gml:GeometryStyle>
            </gml:geometryStyle>
            <gml:GeometryStyle geometryProperty="xima:boundary"
geometryType="gml:Envelope">
              <gml:symbol symbolType="other" xlink:href=" file//c/BuildingPhoto.jpg "/>
            </gml:GeometryStyle>
          </gml:featureStyle>
        </gml:featureStyle>
      </gml:Style>
    </gml:defaultStyle>
    <xima:fileURI>file//c/BuildingPhoto.jpg</xima:fileURI>
    <xima:boundary>
      <gml:Envelope>
        <gml:lowerCorner>1 1</gml:lowerCorner>
        <gml:upperCorner>20 20</gml:upperCorner>
      </gml:Envelope>
    </xima:boundary>
  </Image>
</content>

```

```
</Image>
</content>
<annotates>
  <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
    <gml:pos>30 30</gml:pos>
  </gml:Point>
</annotates>
</PointOfInterest>
```

7.5 Coordinate Reference System Encoding

Coordinate Reference Systems (CRS) may be optionally included as dictionary entries in the dictionary instance box (see Clause 8.). These must be encoded in GML and may depend on additional CRS application schemas. Only one dictionary is permitted in the JPEG 2000 file and this must include all CRS and/or units of measure definitions that are referenced within the JPEG 2000 GML instance data (i.e. from the gml:root-instance box – See Clause 8).

7.6 Units of Measure Encoding

Units of Measure (uom) may be optionally included as dictionary entries in the dictionary instance box (see Clause 8.). These must be encoded in GML and may depend on additional uom application schemas. Only one dictionary is permitted in the JPEG 2000 file and this must include all CRS and/or units of measure definitions that are referenced within the JPEG 2000 GML instance data (i.e. from the gml:root-instance box – See Clause 8).

8 Packaging GML in JPEG 2000

This section describes the mechanisms for packaging GML instance data and 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 GML coverage descriptions (see Clause 6.1 and 7.1) and JPEG 2000 codestreams. All encodings use the JPX data package as defined in the JPEG 2000 Part II (get exact title ..) specification.

All GML instance and schema data is stored in assoc boxes. This means that all JPEG 2000 files which contain GML data MUST be JPX format per JPEG 2000 Part II.

8.1 Single Codestream Case

A single JPEG 2000 codestream is used to represent a single geographic image. The GML data (instance data, schemas) associated within this codestream is contained in a JPX assoc box as shown in Figure 8-1.

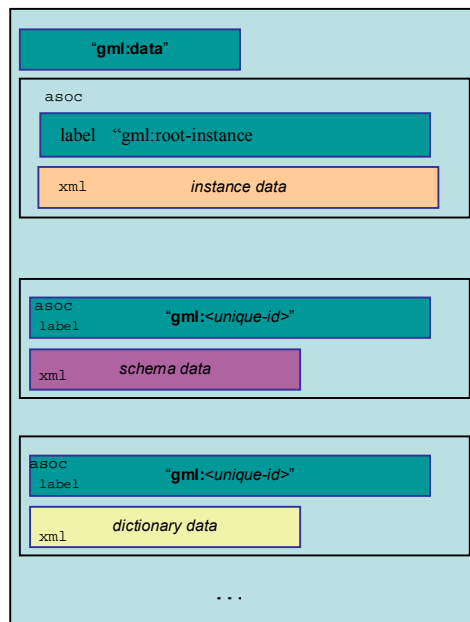


Figure 8.1 Packaging of GML for a Single Codestream

The single “outer” assoc box contains a box-first which is a label box. This must contain the label gml:data.

The outer assoc box must contain at least one additional assoc box containing GML instance data. This assoc box must have a box-first that is a label box with the label

`gml:root-instance` and an XML box. This XML box may only contain GML instance data for the following items:

- Coverage description (see Clause 6.1 and 7.1)
- Metadata instances (see Clause 6.2 and 7.2)
- Annotation instances (see Clause 6.3 and 7.3)
- Feature instances (see Clause 6.4 and 7.4)

The box labelled `gml:root-instance` must not contain XML schemas and must not contain CRS nor units of measure dictionary instances.

Any number of `assoc` boxes may follow the `gml:root-instance` box. Only one of these boxes is to contain dictionary instance data, and such instance data is to contain both CRS and units of measure definitions if applicable. The other following `assoc` boxes may contain only XML schemas and such schemas must be referenced by the XML within the `gml:root-instance` as described in Clause 8.4 and 8.5.

Each of the `assoc` boxes, other than the `gml:root-instance` and containing `gml:data` boxes must have a label (the box-first must be a label box in each case), however the value of the label is arbitrary. This label will be used in references to the XML box content using the mechanism described in Clause 8.5.

The minimal structure for the Single Codestream (= single image) case is then as shown in Figure 8-2.

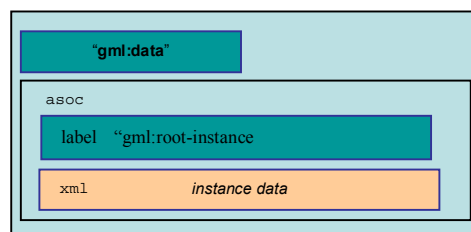


Figure 8-2 Minimal Packaging of GML for a Single Codestream

Note that the instance box **MUST** contain the following:

- GML Coverage Description

The instance box **MAY** contain zero or more of the following:

- Coverage metadata. This **MUST** be referenced by the GML `metadataProperty` from the Coverage description.
- Image Annotations (per the GML Annotation Schema described in Clause 9).

- Associated geographic features (expressed as GML features)

Note that the instance box MUST not contain dictionary definitions for Coordinate Reference Systems, nor for Units of Measure. If these are to be supplied then an additional dictionary box must be provided as in Figure 8-1.

8.2 Multiple Codestream Case

The multiple codestream encoding enables multiple image 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.

The structure of the JPEG 2000 file for the multiple codestream case is shown in Figure 8-3.

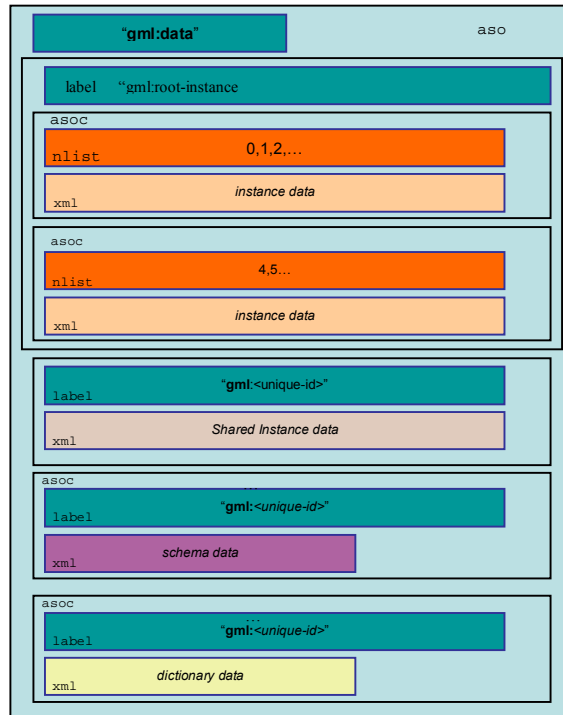


Figure 8.3 Packaging of GML for Multiple Codestreams

The single “outer” assoc box contains a box-first which is a label box. This must contain the label gml:data.

The outer assoc box must contain at least one additional assoc box containing the GML associated to each codestream. This assoc box must have a box-first that is a label box with the label gml:root-instance. This gml:root-instance assoc box may then contain one or more assoc boxes, one for each codestream. Each codestream specific assoc box then consists of a number list box that references the associated codestream and an XML box

that contains the GML data for that codestream. Note that since such codestream specific assoc boxes are not labelled, it is not possible to reference instance data in these boxes from instance data in any other box.

The codestream specific XML box MUST contain the following:

- Coverage description for the associated codestream (see Clause 6.1 and 7.1)

The codestream specific XML box MAY contain zero or more the following:

- Coverage metadata. This MUST be referenced by the GML metadataProperty from the Coverage description.
- Image Annotations (per the GML Annotation Schema described in Clause 9).
- Associated geographic features (expressed as GML features)

The box labelled gml:root-instance must not contain XML schemas and must not contain CRS nor units of measure dictionary instances.

Any number of assoc boxes may follow the gml:root-instance box. Only one of these boxes is to contain dictionary instance data, and such instance data is to contain both CRS and units of measure definitions if applicable. The other following assoc boxes may contain only XML schemas and such schemas must be referenced by the XML within the gml:root-instance as described in Clause 8.4 and 8.5.

Each of the assoc boxes, other than the gml:root-instance and containing gml:data boxes must have a label (the box-first must be a label box in each case), however the value of the label is arbitrary. This label will be used in references to the XML box content using the mechanism described in Section 8.5.

The minimal box structure in the multiple codestream case is shown in Figure 8-4.

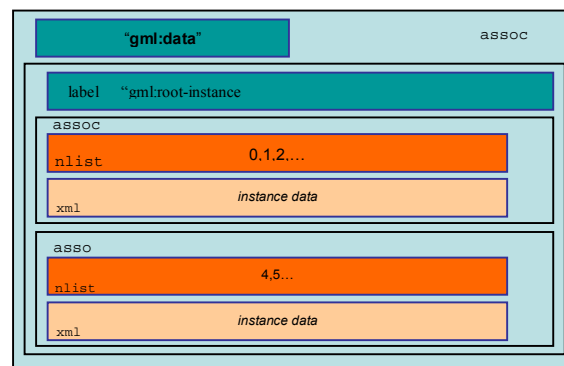


Figure 8.4 Minimal Packaging of GML for Multiple Codestreams

8.3 References to XML Schemas

GML instance data may reference a supporting XML Schema (GML Application Schema) through the XML Schema, schema location attribute (`xsi:schemaLocation`) whose value is a list of URI pairs (namespace, schemaLocation). When used in JPEG 2000 packages the schemaLocation attribute is mandatory and MUST comply with the following:

- Reference to the schemaLocation must be by URN using the URN convention described in Section 8.5, where such references refer to schemas within the JPEG 2000 file.

The processor of the GML/JPEG 2000 package must following the assessment rules for schemas as laid out in XML Schema Specification, Part I Structures, Section 4.3.2 How Schemas are located on the Web, Schema Representation Constraint: Schema Document Location Strategy. 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.”

8.4 References to XML Instances

GML instance data in the root-instance box and in the dictionary instance box may reference GML data, other XML data, or non-XML data through the use of URI references (e.g. xlink:href, gml:uom, gml:srsName, gml:resultOf). When used in JPEG 2000 data packages such references **MUST** be encoded as URN. Where such references point to data within the JPEG 2000 file, the URN must be encoded in accordance with Clause 8.5. Note that instances (e.g. GML elements) can only be referenced within labelled boxes.

8.5 URN References within JPEG 2000 files

This clause describes a URN structure for references to schemas and instance elements that reside within the JPEG 2000 file. URN's are required for ALL references from within GML instance data within the JPEG 2000 file as described in Clause 8.3 and Clause 8.4.

The structure of a URN for references within JPEG 2000 files is as follows:

urn:jp2k:Label:FileExtension:ObjectType:ObjectID

where:

- “jp2k” is the namespace authority
- “Label” is a JPEG 2000 box label and must be unique for the entire JPEG 2000 file.
- “FileExtension” has the value “xml” for instance data and “xsd” for XML Schemas.
- “ObjectType” refers to the GML object type that is referenced.
- “ObjectId” refers to the XML ID of the referenced GML object instance.

In the case of a schema reference (see Clause 8.3) the ObjectType and ObjectId are not required, so the encoding would be of the form:

urn:jp2k:Label:xsd::

Annex A (normative)

Annotation Schema

A.1 General

The GML application schema for Annotation to be used within a JPEG2000 package is given in Clause A.2. Sample Annotation instances are given in Annex B.

A.2 Annotation.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.opengis.net/xima" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml" xmlns:xima="http://www.opengis.net/xima"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-Instance"
elementFormDefault="qualified" attributeFormDefault="unqualified">
  <!--=====-->
  <import namespace="http://www.opengis.net/gml" schemaLocation="gml3.1/base/gml.xsd"/>
  <import namespace="http://www.w3.org/1999/xlink" schemaLocation="gml3.1/xlink/xlinks.xsd"/>
  <!--=====-->
  <element name="_Annotation" type="xima:AnnotationType" abstract="true"
substitutionGroup="gml:_Feature"/>
  <!--=====-->
  <element name="Annotation" type="xima:AnnotationType"/>
  <!--=====-->
  <complexType name="AnnotationType">
    <complexContent>
      <extension base="xima:AnnotationBaseType">
        <sequence>
          <element name="pointer" type="gml:CurvePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
          <element ref="xima:content"/>
          <element name="annotates" type="gml:GeometryPropertyType"/>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
  <!--=====-->
  <element name="content">
    <complexType>
      <sequence>
        <element ref="xima:_AnnotationBase" maxOccurs="unbounded"/>
      </sequence>
    </complexType>
  </element>
  <!--=====-->
  <element name="_AnnotationBase" type="xima:AnnotationBaseType" abstract="true"
substitutionGroup="gml:_Feature"/>
  <!--=====-->
  <complexType name="AnnotationBaseType">
    <complexContent>
      <extension base="xima:AbstractAnnotationBaseType">
        <sequence>
          <element ref="gml:defaultStyle" minOccurs="0" maxOccurs="unbounded"/>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
  <!--=====-->
```

```

        </sequence>
      </extension>
    </complexContent>
  </complexType>
<!--=====-->
<complexType name="AbstractAnnotationBaseType">
  <complexContent>
    <restriction base="gml:AbstractFeatureType">
      <sequence>
        <element ref="gml:metaDataProperty" minOccurs="0" maxOccurs="unbounded"/>
        <element ref="gml:description" minOccurs="0"/>
        <element ref="gml:name" minOccurs="0" maxOccurs="unbounded">
          <annotation>
            <documentation>Multiple names may be provided. These will often be distinguished
by being assigned by different authorities, as indicated by the value of the codeSpace attribute. In an instance
document there will usually only be one name per authority. </documentation>
          </annotation>
        </element>
      </sequence>
    </restriction>
  </complexContent>
</complexType>
<!--=====-->
<element name="Label" type="xima:LabelType" substitutionGroup="xima:_AnnotationBase">
  <annotation>
    <documentation>
      Label is a means of placing text relative to a specific geographic location. The appearance of the
label is determined by the associated style.
    </documentation>
  </annotation>
</element>
<!--=====-->
<complexType name="LabelType">
  <complexContent>
    <extension base="xima:AnnotationBaseType">
      <sequence>
        <element name="textContent" type="string"/>
        <element name="anchorPoint" type="gml:PointPropertyType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<!--=====-->
<element name="Image" type="xima:ImageType" substitutionGroup="xima:_AnnotationBase">
  <annotation>
    <documentation>
      Image is a means of placing an image relative to a specific geometric location. The appearance of
the image is determined by the associated style.
    </documentation>
  </annotation>
</element>
<!--=====-->
<complexType name="ImageType">
  <complexContent>
    <extension base="xima:AnnotationBaseType">
      <sequence>
        <element name="fileURI" type="anyURI"/>
        <element name="boundary" type="xima:EnvelopePropertyType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<!--=====-->
<complexType name="EnvelopePropertyType">
  <sequence>

```

```

        <element ref="gml:Envelope"/>
    </sequence>
</complexType>
<!--=====-->
<element name="PointOfInterest" type="xima:PointOfInterestType" substitutionGroup="xima:_Annotation">
    <annotation>
        <documentation>
            PointOfInterest is a means of indicating a point of interest on an image or map or in a geographic
            dataset. No specific feature is attached to the point in question. The PointOfInterest can have an arrow (pointing at
            the POI) and a Label or Image.
        </documentation>
    </annotation>
</element>
<!--=====-->
<complexType name="PointOfInterestType">
    <complexContent>
        <restriction base="xima:AnnotationType">
            <sequence>
                <element ref="gml:metaDataProperty" minOccurs="0" maxOccurs="unbounded"/>
                <element ref="gml:description" minOccurs="0"/>
                <element ref="gml:name" minOccurs="0" maxOccurs="unbounded"/>
                <element ref="gml:defaultStyle" minOccurs="0" maxOccurs="unbounded"/>
                <element name="pointer" type="gml:CurvePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                <element ref="xima:content"/>
                <element name="annotates" type="gml:PointPropertyType"/>
            </sequence>
        </restriction>
    </complexContent>
</complexType>
<!--=====-->
<element name="CurveOfInterest" type="xima:CurveOfInterestType" substitutionGroup="xima:_Annotation">
    <annotation>
        <documentation>
            PointOfInterest is a means of indicating a point of interest on an image or map or in a geographic
            dataset. No specific feature is attached to the point in question. The PointOfInterest can have an arrow (pointing at
            the POI) and a Label or Image.
        </documentation>
    </annotation>
</element>
<!--=====-->
<complexType name="CurveOfInterestType">
    <complexContent>
        <restriction base="xima:AnnotationType">
            <sequence>
                <element ref="gml:metaDataProperty" minOccurs="0" maxOccurs="unbounded"/>
                <element ref="gml:description" minOccurs="0"/>
                <element ref="gml:name" minOccurs="0" maxOccurs="unbounded"/>
                <element ref="gml:defaultStyle" minOccurs="0" maxOccurs="unbounded"/>
                <element name="pointer" type="gml:CurvePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                <element ref="xima:content"/>
                <element name="annotates" type="gml:CurvePropertyType"/>
            </sequence>
        </restriction>
    </complexContent>
</complexType>
<!--=====-->
<element name="RegionOfInterest" type="xima:RegionOfInterestType"
substitutionGroup="xima:_Annotation">
    <annotation>
        <documentation>
            Region of interest is a means of hi-lighting a region on an image or map. The region is bounded by
            a polygon, may have an indicator arrow, and either Label or Image.
        </documentation>

```

```

    </annotation>
  </element>
  <!--=====-->
  <complexType name="RegionOfInterestType">
    <complexContent>
      <restriction base="xima:AnnotationType">
        <sequence>
          <element ref="gml:metaDataProperty" minOccurs="0" maxOccurs="unbounded"/>
          <element ref="gml:description" minOccurs="0"/>
          <element ref="gml:name" minOccurs="0" maxOccurs="unbounded"/>
          <element ref="gml:defaultStyle" minOccurs="0" maxOccurs="unbounded"/>
          <element name="pointer" type="gml:CurvePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
          <element ref="xima:content"/>
          <element name="annotates" type="gml:PolygonPropertyType"/>
        </sequence>
      </restriction>
    </complexContent>
  </complexType>
  <!--=====-->
  <element name="FeatureOfInterest" type="xima:FeatureOfInterestType"
substitutionGroup="xima:_Annotation">
    <annotation>
      <documentation>
        Feature of interest is a means of hi-lighting a feature on an image or map. The feature is indicated
        by an arrow Label or Image.
      </documentation>
    </annotation>
  </element>
  <!--=====-->
  <complexType name="FeatureOfInterestType">
    <complexContent>
      <extension base="xima:AnnotationType">
        <sequence>
          <element ref="gml:featureMember" minOccurs="0"/>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
  <!--=====-->
  <element name="AnnotationMetaData" substitutionGroup="gml:_MetaData">
    <complexType mixed="true">
      <complexContent mixed="true">
        <extension base="gml:AbstractMetaDataType">
          <sequence>
            <group ref="xima:properties"/>
          </sequence>
        </extension>
      </complexContent>
    </complexType>
  </element>
  <!--=====-->
  <group name="properties">
    <sequence>
      <element ref="xima:title" minOccurs="0"/>
      <element ref="xima:author" minOccurs="0"/>
      <element ref="xima:dateTime" minOccurs="0"/>
      <sequence minOccurs="0">
        <element ref="xima:certainty"/>
        <element ref="xima:rationale" minOccurs="0"/>
      </sequence>
    </sequence>
  </group>
  <!--=====-->
  <element name="title" type="string"/>
  <element name="author" type="string"/>

```

```
<element name="dateTime" type="dateTime"/>  
<element name="certainty" type="string"/>  
<element name="rationale" type="string"/>  
<!--=====-->  
</schema>
```

Annex B (informative)

Annotation Instances

B.1 General

Sample annotation instances that validate against Annotation.xsd (Annex A) are given in Subclauses B.1.1 to B.1.4.

B.1.1 PointOfInterest.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<PointOfInterest gml:id="POI001" xmlns="http://www.opengis.net/xima" xmlns:gml="http://www.opengis.net/gml"
xmlns:xima="http://www.opengis.net/xima" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/gml
gml3.1/base/gml.xsd http://www.opengis.net/xima Annotation.xsd">
  <gml:metaDataProperty>
    <AnnotationMetaData>
      <title>Some point of interest</title>
      <author>Author Name</author>
      <dateTime>2004-12-12T01:01:01</dateTime>
      <certainty>medium</certainty>
      <rationale>proximity of point is a close match to that of known building</rationale>
    </AnnotationMetaData>
  </gml:metaDataProperty>
  <gml:defaultStyle>
    <!--Style overlays some arrow or line symbol on top of Annotation/pointer value-->
    <gml:Style>
      <gml:featureStyle>
        <gml:FeatureStyle featureType="PointOfInterest" queryGrammar="xpath">
          <gml:geometryStyle>
            <gml:GeometryStyle geometryProperty="pointer" geometryType="gml:LineString">
              <gml:style>stroke:blue;stroke-width:5</gml:style>
            </gml:GeometryStyle>
          </gml:geometryStyle>
        </gml:FeatureStyle>
      </gml:featureStyle>
    </gml:Style>
  </gml:defaultStyle>
  <gml:defaultStyle>
    <!--Style overlays point symbol on annotates property value-->
    <gml:Style>
      <gml:featureStyle>
        <gml:FeatureStyle featureType="PointOfInterest" queryGrammar="xpath">
          <gml:geometryStyle>
            <gml:GeometryStyle geometryProperty="annotates" geometryType="gml:Point">
              <gml:symbol symbolType="svg" xlink:href="http://symbology.com/stars.svg#Star01"/>
            </gml:GeometryStyle>
          </gml:geometryStyle>
        </gml:FeatureStyle>
      </gml:featureStyle>
    </gml:Style>
  </gml:defaultStyle>
  <pointer>
```

```

    <gml:LineString gml:id="L001">
      <gml:pos>12 34</gml:pos>
      <gml:pos>45 36</gml:pos>
      <gml:pos>78 34</gml:pos>
    </gml:LineString>
  </pointer>
</content>
<Image>
  <gml:defaultStyle>
    <!--Style places image file inside boundary Envelope-->
    <gml:Style>
      <gml:featureStyle>
        <gml:FeatureStyle featureType="Image" queryGrammar="xpath">
          <gml:geometryStyle>
            <gml:GeometryStyle geometryProperty="xima:boundary"
geometryType="gml:Envelope">
              <gml:style>stroke:maroon;stroke-width:5</gml:style>
            </gml:GeometryStyle>
          </gml:geometryStyle>
          <gml:GeometryStyle geometryProperty="xima:boundary"
geometryType="gml:Envelope">
            <gml:symbol symbolType="other" xlink:href="file:///c:/BuildingPhoto.jpg"/>
          </gml:GeometryStyle>
        </gml:featureStyle>
      </gml:Style>
    </gml:defaultStyle>
    <xima:fileURI>file:///c:/BuildingPhoto.jpg</xima:fileURI>
    <xima:boundary>
      <gml:Envelope>
        <gml:lowerCorner>1 1</gml:lowerCorner>
        <gml:upperCorner>20 20</gml:upperCorner>
      </gml:Envelope>
    </xima:boundary>
  </Image>
</content>
<annotates>
  <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002.xml:crs:id">
    <gml:pos>30 30</gml:pos>
  </gml:Point>
</annotates>
</PointOfInterest>

```

B.1.2 CurveOfInterest.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<CurveOfInterest gml:id="COI001" xmlns="http://www.opengis.net/xima" xmlns:gml="http://www.opengis.net/gml"
xmlns:xima="http://www.opengis.net/xima" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/gml
gml3.1/base/gml.xsd http://www.opengis.net/xima Annotation.xsd">
  <gml:metaDataProperty>
    <AnnotationMetaData>
      <title>A curve of interest</title>
      <author>Author Name</author>
      <dateTime>2004-12-12T01:01:01</dateTime>
      <certainty>medium</certainty>
      <rationale>shape of polygon is a close match to that of known region of interest</rationale>
    </AnnotationMetaData>
  </gml:metaDataProperty>
  <gml:defaultStyle>

```

```

    <!--Style will overlay some arrow or line symbol on top of Annotation/pointer value-->
  </gml:defaultStyle>
  <gml:defaultStyle>
    <!--Style will overlay line symbol(s) on annotates property value-->
  </gml:defaultStyle>
  <pointer>
    <gml:LineString gml:id="L001">
      <gml:pos>12 34</gml:pos>
      <gml:pos>45 36</gml:pos>
      <gml:pos>78 34</gml:pos>
    </gml:LineString>
  </pointer>
  <content>
    <Label>
      <gml:defaultStyle>
        <!--Style will place textContent value at anchorPoint at some angle-->
      </gml:defaultStyle>
      <xima:textContent>Text Describing Curve of Interest</xima:textContent>
      <xima:anchorPoint>
        <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
          <gml:pos>0 10</gml:pos>
        </gml:Point>
      </xima:anchorPoint>
    </Label>
  </content>
  <annotates>
    <gml:LineString gml:id="L002">
      <gml:pos>22 44</gml:pos>
      <gml:pos>55 77</gml:pos>
      <gml:pos>88 100</gml:pos>
    </gml:LineString>
  </annotates>
</CurveOfInterest>

```

B.1.3 RegionOfInterest.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<RegionOfInterest gml:id="ROI001" xmlns="http://www.opengis.net/xima" xmlns:gml="http://www.opengis.net/gml"
xmlns:xima="http://www.opengis.net/xima" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/gml
gml3.1/base/gml.xsd http://www.opengis.net/xima Annotation.xsd">
  <gml:metaDataProperty>
    <AnnotationMetaData>
      <title>A single region of interest</title>
      <author>Author Name</author>
      <dateTime>2004-12-12T01:01:01</dateTime>
      <certainty>medium</certainty>
      <rationale>shape of polygon is a close match to that of known region of interest</rationale>
    </AnnotationMetaData>
  </gml:metaDataProperty>
  <gml:defaultStyle>
    <!--Style will overlay some arrow or line symbol on top of Annotation/pointer value-->
  </gml:defaultStyle>
  <gml:defaultStyle>
    <!--Style will fill in Polygon in annotates property value-->
  </gml:defaultStyle>
  <pointer>
    <gml:LineString gml:id="L001">
      <gml:pos>12 34</gml:pos>
      <gml:pos>45 36</gml:pos>
      <gml:pos>78 34</gml:pos>
    </gml:LineString>
  </pointer>

```



```

    </gml:LineString>
  </pointer>
</content>
<Label>
  <gml:defaultStyle>
    <!--Style will place textContent value at anchorPoint at some angle-->
  </gml:defaultStyle>
  <xima:textContent>Text Describing Region of Interest</xima:textContent>
  <xima:anchorPoint>
    <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
      <gml:pos>0 10</gml:pos>
    </gml:Point>
  </xima:anchorPoint>
</Label>
</content>
<annotates>
  <gml:Polygon gml:id="PI001">
    <gml:exterior>
      <gml:LinearRing>
        <gml:pos>22 44</gml:pos>
        <gml:pos>55 77</gml:pos>
        <gml:pos>88 100</gml:pos>
        <gml:pos>22 44</gml:pos>
      </gml:LinearRing>
    </gml:exterior>
  </gml:Polygon>
</annotates>
</RegionOfInterest>

```

B.1.4 FeatureOfInterest.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<FeatureOfInterest gml:id="FOI001" xmlns="http://www.opengis.net/xima" xmlns:gml="http://www.opengis.net/gml"
xmlns:xima="http://www.opengis.net/xima" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/gml
gml3.1/base/gml.xsd http://www.opengis.net/xima Annotation.xsd">
  <gml:metaDataProperty>
    <AnnotationMetaData>
      <title>A building feature of interest</title>
      <author>Author Name</author>
      <dateTime>2004-12-12T01:01:01</dateTime>
      <certainty>high</certainty>
    </AnnotationMetaData>
  </gml:metaDataProperty>
  <gml:defaultStyle>
    <!--Style will overlay some arrow or line symbol on top of Annotation/pointer value-->
  </gml:defaultStyle>
  <gml:defaultStyle>
    <!--Style will overlay point symbol on annotates property value-->
  </gml:defaultStyle>
  <pointer>
    <gml:LineString gml:id="L001">
      <gml:pos>12 34</gml:pos>
      <gml:pos>45 36</gml:pos>
      <gml:pos>78 34</gml:pos>
    </gml:LineString>
  </pointer>
  <content>
    <Image>
      <gml:defaultStyle>
        <!--Style will place image file inside boundary Envelope-->

```

```

    </gml:defaultStyle>
    <xima:fileURI>file://c/BuildingPhoto.jpg</xima:fileURI>
    <xima:boundary>
      <gml:Envelope>
        <gml:lowerCorner>1 1</gml:lowerCorner>
        <gml:upperCorner>20 20</gml:upperCorner>
      </gml:Envelope>
    </xima:boundary>
  </Image>
</content>
<annotates>
  <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002:xml:crs:id">
    <gml:pos>30 30</gml:pos>
  </gml:Point>
</annotates>
<gml:featureMember xlink:href="www.abc.com/building.xml#B001"/>
</FeatureOfInterest>

```

B.1.5 Annotation.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<Annotation gml:id="AN001" xmlns="http://www.opengis.net/xima" xmlns:gml="http://www.opengis.net/gml"
xmlns:xima="http://www.opengis.net/xima" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/gml
gml3.1/base/gml.xsd http://www.opengis.net/xima Annotation.xsd">
  <gml:metaDataProperty>
    <AnnotationMetaData>
      <title>Two regions of interest</title>
      <author>Author Name</author>
      <dateTime>2004-12-12T01:01:01</dateTime>
      <certainty>medium</certainty>
      <rationale>shape of polygons and proximity are a close match to that of known regions of
interest</rationale>
    </AnnotationMetaData>
  </gml:metaDataProperty>
  <gml:defaultStyle>
    <!--Style will overlay some arrow or line symbol on top of Annotation/pointer value-->
  </gml:defaultStyle>
  <gml:defaultStyle>
    <!--Style will overlay some other arrow or line symbol on top of the other Annotation/pointer value-->
  </gml:defaultStyle>
  <gml:defaultStyle>
    <!--Style will fill in member Polygons in annotates MultiPolygon property value-->
  </gml:defaultStyle>
  <pointer>
    <gml:LineString gml:id="L001">
      <gml:pos>12 34</gml:pos>
      <gml:pos>45 36</gml:pos>
      <gml:pos>78 34</gml:pos>
    </gml:LineString>
  </pointer>
  <pointer>
    <gml:LineString gml:id="L002">
      <gml:pos>102 34</gml:pos>
      <gml:pos>135 36</gml:pos>
      <gml:pos>168 34</gml:pos>
    </gml:LineString>
  </pointer>
  <content>
    <Label>
      <gml:defaultStyle>

```

```

    <!--Style will place textContent value at anchorPoint at some angle-->
  </gml:defaultStyle>
  <xima:textContent>Text Describing Region1 of Interest</xima:textContent>
  <xima:anchorPoint>
    <gml:Point gml:id="Pt001" srsName="urn:jp2k:label002.xml:crs:id">
      <gml:pos>0 10</gml:pos>
    </gml:Point>
  </xima:anchorPoint>
</Label>
<Label>
  <gml:defaultStyle>
    <!--Style will place textContent value at anchorPoint at some angle-->
  </gml:defaultStyle>
  <xima:textContent>Text Describing Region2 of Interest</xima:textContent>
  <xima:anchorPoint>
    <gml:Point gml:id="Pt002" srsName="urn:jp2k:label002.xml:crs:id">
      <gml:pos>90 10</gml:pos>
    </gml:Point>
  </xima:anchorPoint>
</Label>
</content>
<annotates>
  <gml:MultiSurface gml:id="MP001" srsName="urn:jp2k:label.xml:crs:id">
    <gml:surfaceMember>
      <gml:Polygon gml:id="PI001">
        <gml:exterior>
          <gml:LinearRing>
            <gml:pos>22 44</gml:pos>
            <gml:pos>55 77</gml:pos>
            <gml:pos>88 100</gml:pos>
            <gml:pos>22 44</gml:pos>
          </gml:LinearRing>
        </gml:exterior>
      </gml:Polygon>
    </gml:surfaceMember>
    <gml:surfaceMember>
      <gml:Polygon gml:id="PI002">
        <gml:exterior>
          <gml:LinearRing>
            <gml:pos>102 34</gml:pos>
            <gml:pos>135 67</gml:pos>
            <gml:pos>168 90</gml:pos>
            <gml:pos>102 34</gml:pos>
          </gml:LinearRing>
        </gml:exterior>
      </gml:Polygon>
    </gml:surfaceMember>
  </gml:MultiSurface>
</annotates>
</Annotation>

```

Annex C (informative)

Single and Multiple Schemas and Instances

C.1 General

Sample application schemas are given in Clauses C.2 and C.4 corresponding to a Single Code Stream and Multiple Code Stream, respectively. Corresponding sample instances for a single and multiple code stream is given in Clauses C.3 and C.5.

C.2 Sample Application Schemas for Single Code Stream

C.2.1 CoverageSchema.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.spain.org" xmlns:app="http://www.spain.org"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
elementFormDefault="qualified" attributeFormDefault="unqualified">
  <import namespace="http://www.opengis.net/gml" schemaLocation="../gml4jp2.xsd"/>
  <!-- =====>
  <element name="AverageTemp" type="gml:RectifiedGridCoverageType"
substitutionGroup="gml:_Coverage"/>
  <element name="AveragePressure" type="gml:RectifiedGridCoverageType"
substitutionGroup="gml:_Coverage"/>
  <!-- =====>
  <element name="Temperature" type="gml:MeasureOrNullListType" substitutionGroup="gml:_Value"/>
  <!-- =====>
  <element name="Pressure" type="gml:MeasureOrNullListType" substitutionGroup="gml:_Value"/>
</schema>
```

C.2.2 FeatureSchema.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.france.org" xmlns:gml="http://www.opengis.net/gml"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:app="http://www.france.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <import namespace="http://www.opengis.net/gml" schemaLocation="../gml4jp2.xsd"/>
  <element name="City" type="app:CityType" substitutionGroup="gml:_FeatureCollection"/>
  <complexType name="CityType">
    <complexContent>
      <extension base="gml:AbstractFeatureCollectionType">
        <sequence/>
      </extension>
    </complexContent>
  </complexType>
  <!-- =====>
  <element name="LandParcel" type="app:LandParcelType" substitutionGroup="gml:_FeatureCollection"/>
  <complexType name="LandParcelType">
    <complexContent>
      <extension base="gml:AbstractFeatureCollectionType">
        <sequence/>
      </extension>
    </complexContent>
  </complexType>
```

```

                <element name="numberOfBuildings" type="integer"/>
                <element ref="gml:extentOf" minOccurs="0"/>
            </sequence>
        </extension>
    </complexContent>
</complexType>
<!-- =====>
<element name="_Street" type="gml:AbstractFeatureType" abstract="true"
substitutionGroup="gml:_Feature"/>
<element name="Street" type="app:StreetType" substitutionGroup="app:_Street"/>
<complexType name="StreetBaseType">
    <complexContent>
        <restriction base="gml:AbstractFeatureCollectionType">
            <sequence>
                <element ref="gml:metaDataProperty" minOccurs="0"/>
                <element ref="gml:description" minOccurs="0"/>
                <element ref="gml:name" minOccurs="0" maxOccurs="unbounded"/>
                <element ref="gml:boundedBy"/>
            </sequence>
        </restriction>
    </complexContent>
</complexType>
<!-- =====>
<complexType name="StreetType">
    <complexContent>
        <extension base="app:StreetBaseType">
            <sequence>
                <element name="streetMember" type="app:StreetMemberPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                <element ref="gml:centerLineOf" minOccurs="0"/>
            </sequence>
        </extension>
    </complexContent>
</complexType>
<!-- =====>
<complexType name="StreetMemberPropertyType">
    <annotation>
        <documentation>Container for a street or streetSegment - follow gml:AssociationType
pattern.</documentation>
    </annotation>
    <sequence>
        <element ref="app:_Street" minOccurs="0"/>
    </sequence>
    <attributeGroup ref="gml:AssociationAttributeGroup"/>
</complexType>
<!-- =====>
<element name="StreetSegment" type="app:StreetSegmentType" substitutionGroup="app:_Street"/>
<complexType name="StreetSegmentType">
    <complexContent>
        <extension base="gml:AbstractFeatureType">
            <sequence>
                <element name="numberLanes" type="positiveInteger"/>
                <element ref="gml:centerLineOf" minOccurs="0"/>
                <element name="intersects" type="gml:FeaturePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
            </sequence>
        </extension>
    </complexContent>
</complexType>
<!-- =====>
</schema>

```

C.3 Sample Instances for Single Code Stream

C.3.1 RootInstance.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<gml:FeatureCollection xmlns="http://www.opengis.org/schema/gml-jp2" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:exp1="http://www.spain.org" xmlns:exp2="http://www.france.org"
xsi:schemaLocation="http://www.opengis.net/gml ../gml4jp2.xsd http://www.spain.org CoverageSchema.xsd
http://www.france.org FeatureSchema.xsd">
```

```
  <!-- All schema location file path references from within a jp2 file will using the urn format:
  urn:jp2k:label003:xsd::
```

where "jp2k" represents the namespace authority for this urn, "label003" represents the label ID of the assoc box, and "xsd" is the XML file extension of the XML file inside the XMLBox.

```
  -->
  <gml:description>This GML/JPEG 2000 Root Instance contains a GML coverage description and a GML
  feature descriptions of the geographic features embedded in the image</gml:description>
```

```
  <gml:name>Root Instance</gml:name>
  <gml:boundedBy>
    <gml:Null>missing</gml:Null>
  </gml:boundedBy>
  <gml:featureMembers>
    <exp1:AverageTemp dimension="2" gml:id="AT0001">
      <gml:rectifiedGridDomain>
        <gml:RectifiedGrid dimension="2">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>1 1</gml:low>
              <gml:high>4 4</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisName>u</gml:axisName>
          <gml:axisName>v</gml:axisName>
          <gml:origin>
            <gml:Point gml:id="P0001" srsName="urn:jp2k:label002:xml:crs:c1123">
              <gml:coordinates>1.2 3.4</gml:coordinates>
            </gml:Point>
          </gml:origin>
          <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">1 2</gml:offsetVector>
          <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">4 5</gml:offsetVector>
        </gml:RectifiedGrid>
      </gml:rectifiedGridDomain>
      <gml:rangeSet>
        <gml:File>
          <gml:rangeParameters>
            <exp1:Temperature
              uom="urn:jp2k:label002:xml:uom:degC">template</exp1:Temperature>
          </gml:rangeParameters>
          <gml:fileName>file123.jp2</gml:fileName>
          <gml:fileStructure>Record Interleaved</gml:fileStructure>
        </gml:File>
      </gml:rangeSet>
    </exp1:AverageTemp>
    <exp2:City>
      <gml:boundedBy>
        <gml:Envelope srsName="urn:jp2k:label002:xml:crs:c1123">
          <gml:pos>0 0</gml:pos>
          <gml:pos>150 100</gml:pos>
        </gml:Envelope>
      </gml:boundedBy>
      <gml:featureMembers>
        <exp2:LandParcel gml:id="LP1">
          <gml:boundedBy>
            <gml:Null>withheld</gml:Null>
```

```

</gml:boundedBy>
<exp2:numberOfBuildings>1</exp2:numberOfBuildings>
<gml:extentOf>
  <gml:Polygon srsName="urn:jp2k:label002:xml:crs:c1123">
    <gml:exterior>
      <gml:LinearRing>
        <gml:pos>10.0 50</gml:pos>
        <gml:pos>30 50</gml:pos>
        <gml:pos>30 90</gml:pos>
        <gml:pos>10 90</gml:pos>
        <gml:pos>10 50</gml:pos>
      </gml:LinearRing>
    </gml:exterior>
  </gml:Polygon>
</gml:extentOf>
</exp2:LandParcel>
<exp2:LandParcel gml:id="LP2">
  <gml:boundedBy>
    <gml:Null>withheld</gml:Null>
  </gml:boundedBy>
  <exp2:numberOfBuildings>1</exp2:numberOfBuildings>
  <gml:extentOf>
    <gml:Polygon gml:id="P2" srsName="urn:jp2k:label002:xml:crs:c1123">
      <gml:exterior>
        <gml:LinearRing>
          <gml:coordinates cs="," ts=" " decimal=".">10.0,10 30,10 30,50 10,50
10,10</gml:coordinates>
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </gml:extentOf>
</exp2:LandParcel>
<exp2:StreetSegment gml:id="SS1">
  <gml:name>Elm Street 100 Block</gml:name>
  <exp2:numberLanes>1</exp2:numberLanes>
  <gml:centerLineOf>
    <gml:LineString gml:id="L1">
      <gml:coordinates>10,10 30,10</gml:coordinates>
    </gml:LineString>
  </gml:centerLineOf>
  <exp2:intersects xlink:href="#SS2"/>
</exp2:StreetSegment>
<exp2:StreetSegment gml:id="SS2">
  <gml:name>Alder Street 100 Block</gml:name>
  <exp2:numberLanes>1</exp2:numberLanes>
  <gml:centerLineOf>
    <gml:LineString gml:id="L2" srsName="#crs1123">
      <gml:coordinates>30,10 30,50</gml:coordinates>
    </gml:LineString>
  </gml:centerLineOf>
  <exp2:intersects xlink:href="#SS1"/>
</exp2:StreetSegment>
<exp2:StreetSegment gml:id="SS3">
  <gml:name>Alder Street 200 Block</gml:name>
  <exp2:numberLanes>1</exp2:numberLanes>
  <gml:centerLineOf>
    <gml:LineString gml:id="L3" srsName="#crs1123">
      <gml:coordinates>30,50 30,90</gml:coordinates>
    </gml:LineString>
  </gml:centerLineOf>
  <exp2:intersects xlink:href="#SS1"/>
</exp2:StreetSegment>
<exp2:Street gml:id="St1">
  <gml:boundedBy>
    <gml:Null>withheld</gml:Null>

```

```

        </gml:boundedBy>
        <exp2:streetMember xlink:href="#SS2"/>
        <exp2:streetMember xlink:href="#SS3"/>
    </exp2:Street>
</gml:featureMembers>
</exp2:City>
</gml:featureMembers>
</gml:FeatureCollection>

```

C.3.2 Dictionary.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<gml:Dictionary gml:id="UnitsAndCRS" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/gml ../gml4jp2.xsd">
    <gml:name>Units of Measure and CRS Dictionary for GML/JPEG 2000 package</gml:name>
    <gml:dictionaryEntry>
        <gml:BaseUnit gml:id="m">
            <gml:name>meter</gml:name>
            <gml:quantityType>length</gml:quantityType>
            <gml:catalogSymbol>m</gml:catalogSymbol>
            <gml:unitsSystem xlink:href="http://www1.bipm.org/en/si/index.html"/>
        </gml:BaseUnit>
    </gml:dictionaryEntry>
    <gml:dictionaryEntry>
        <gml:ConventionalUnit gml:id="cm">
            <gml:name>centimeter</gml:name>
            <gml:quantityType>length</gml:quantityType>
            <gml:conversionToPreferredUnit uom="http://www1.bipm.org/en/si/base_units/index.html#metre">
                <gml:factor>.01</gml:factor>
            </gml:conversionToPreferredUnit>
        </gml:ConventionalUnit>
    </gml:dictionaryEntry>
    <gml:dictionaryEntry>
        <gml:ConventionalUnit gml:id="km">
            <gml:name>kilometer</gml:name>
            <gml:quantityType>length</gml:quantityType>
            <gml:conversionToPreferredUnit uom="http://www1.bipm.org/en/si/base_units/index.html#metre">
                <gml:factor>1000</gml:factor>
            </gml:conversionToPreferredUnit>
        </gml:ConventionalUnit>
    </gml:dictionaryEntry>
    <gml:dictionaryEntry>
        <gml:DerivedUnit gml:id="squareMeter">
            <gml:name>square meter</gml:name>
            <gml:quantityType>area</gml:quantityType>
            <gml:catalogSymbol>m^2</gml:catalogSymbol>
            <gml:unitDerivation>
                <gml:unitTerm uom="http://www1.bipm.org/en/si/base_units/index.html#metre" exponent="2"/>
            </gml:unitDerivation>
        </gml:DerivedUnit>
    </gml:dictionaryEntry>
    <gml:dictionaryEntry>
        <gml:ConventionalUnit gml:id="degC">
            <gml:name>celsius</gml:name>
            <gml:quantityType>temperature</gml:quantityType>
            <gml:catalogSymbol>°C</gml:catalogSymbol>
            <gml:conversionToPreferredUnit uom="http://www1.bipm.org/en/si/derived_units/2-2-1.html#kelvin">
                <gml:formula>
                    <gml:a>273.16</gml:a>
                    <gml:b>1</gml:b>
                    <gml:c>1</gml:c>
                </gml:formula>
            </gml:conversionToPreferredUnit>
        </gml:ConventionalUnit>
    </gml:dictionaryEntry>

```



```

    </gml:ConventionalUnit>
  </gml:dictionaryEntry>
  <gml:dictionaryEntry>
    <gml:ConventionalUnit gml:id="milliBars">
      <gml:name>millibars</gml:name>
      <gml:quantityType>pressure</gml:quantityType>
      <gml:conversionToPreferredUnit uom="http://www1.bipm.org/en/si/derived_units/2-2-2.html#pascal">
        <gml:factor>100</gml:factor>
      </gml:conversionToPreferredUnit>
    </gml:ConventionalUnit>
  </gml:dictionaryEntry>
  <gml:dictionaryEntry>
    <gml:GeographicCRS gml:id="crs1123">
      <gml:srsName>NAD 83 (deg)</gml:srsName>
      <gml:srsID>
        <gml:code>CRS0001</gml:code>
        <gml:codeSpace>X-MSRM</gml:codeSpace>
        <gml:version>0.1</gml:version>
      </gml:srsID>
      <gml:validArea>
        <gml:description>North America</gml:description>
      </gml:validArea>
      <gml:usesEllipsoidalCS>
        <gml:EllipsoidalCS gml:id="X-MSRMCS0001">
          <gml:remarks>Axis order is by element order. Differs from EPSG62696405 EllipsoidalCS in
that axis order is long/lat, as per normal GIS industry dataset convention.</gml:remarks>
          <gml:csName>ellipsoidal</gml:csName>
          <gml:csID>
            <gml:code>CS0001</gml:code>
            <gml:codeSpace>X-MSRM</gml:codeSpace>
            <gml:version>0.1</gml:version>
          </gml:csID>
          <gml:usesAxis>
            <gml:CoordinateSystemAxis gml:id="EPSG9902" gml:uom="urn:x-
epsg:v0.1:uom:degree">
              <gml:remarks>Axis order = 2</gml:remarks>
              <gml:axisName>Geodetic longitude</gml:axisName>
              <gml:axisID>
                <gml:code>9902</gml:code>
                <gml:codeSpace>EPSG</gml:codeSpace>
                <gml:version>6.0</gml:version>
              </gml:axisID>
              <gml:axisAbbrev>Long</gml:axisAbbrev>
              <gml:axisDirection>East</gml:axisDirection>
            </gml:CoordinateSystemAxis>
          </gml:usesAxis>
          <gml:usesAxis>
            <gml:CoordinateSystemAxis gml:id="EPSG9901" gml:uom="urn:x-
epsg:v0.1:uom:degree">
              <gml:remarks>Axis order = 1</gml:remarks>
              <gml:axisName>Geodetic latitude</gml:axisName>
              <gml:axisID>
                <gml:code>9901</gml:code>
                <gml:codeSpace>EPSG</gml:codeSpace>
                <gml:version>6.0</gml:version>
              </gml:axisID>
              <gml:axisAbbrev>Lat</gml:axisAbbrev>
              <gml:axisDirection>North</gml:axisDirection>
            </gml:CoordinateSystemAxis>
          </gml:usesAxis>
        </gml:EllipsoidalCS>
      </gml:usesEllipsoidalCS>
      <gml:usesGeodeticDatum>
        <gml:GeodeticDatum gml:id="EPSG6269">
          <gml:datumName>North American Datum 1983</gml:datumName>

```

```

    <gml:datumID>
      <gml:code>6269</gml:code>
      <gml:codeSpace>EPSG</gml:codeSpace>
      <gml:version>0.1</gml:version>
    </gml:datumID>
    <gml:usesPrimeMeridian>
      <gml:PrimeMeridian gml:id="EPSG8901">
        <gml:meridianName>Greenwich</gml:meridianName>
        <gml:meridianID>
          <gml:code>8901</gml:code>
          <gml:codeSpace>EPSG</gml:codeSpace>
          <gml:version>6.0</gml:version>
        </gml:meridianID>
        <gml:greenwichLongitude>
          <gml:angle uom="urn:x-epsg:v0.1:uom:degree">0</gml:angle>
        </gml:greenwichLongitude>
      </gml:PrimeMeridian>
    </gml:usesPrimeMeridian>
    <gml:usesEllipsoid>
      <gml:Ellipsoid gml:id="EPSG7019">
        <gml:ellipsoidName>GRS 1980</gml:ellipsoidName>
        <gml:ellipsoidID>
          <gml:code>7019</gml:code>
          <gml:codeSpace>EPSG</gml:codeSpace>
          <gml:version>6.0</gml:version>
        </gml:ellipsoidID>
        <gml:semiMajorAxis uom="urn:x-si:v1999:uom:metre">6378137</gml:semiMajorAxis>
        <gml:secondDefiningParameter>
          <gml:inverseFlattening uom="urn:x-
bagug:v0.1:dictionary:ifu">298.257222101</gml:inverseFlattening>
        </gml:secondDefiningParameter>
      </gml:Ellipsoid>
    </gml:usesEllipsoid>
  </gml:GeodeticDatum>
</gml:usesGeodeticDatum>
</gml:GeographicCRS>
</gml:dictionaryEntry>
<gml:dictionaryEntry>
  <gml:ProjectedCRS >
    <gml:srsName>NAD83 / UTM zone 7N</gml:srsName>
    <gml:srsID>
      <gml:code>26907</gml:code>
      <gml:codeSpace>EPSG</gml:codeSpace>
      <gml:version>6.0</gml:version>
    </gml:srsID>
    <gml:validArea>
      <gml:description>North America - between 144 and 138 deg West. Canada - British Columbia
(BC); Yukon. United States (USA) - Alaska (AK).</gml:description>
    </gml:validArea>
    <gml:scope>
      Large and medium scale topographic mapping and engineering survey.</gml:scope>
    <gml:baseCRS xlink:href="#EPSG4269" xlink:title="NAD 83 (deg)"/>
    <gml:definedByConversion>
      <gml:Conversion gml:id="EPSG16007">
        <gml:coordinateOperationName>UTM for zoned grid system</gml:coordinateOperationName>
        <gml:coordinateOperationID>
          <gml:code>16007</gml:code>
          <gml:codeSpace>EPSG</gml:codeSpace>
          <gml:version>6.0</gml:version>
        </gml:coordinateOperationID>
        <gml:usesMethod>
          <gml:OperationMethod gml:id="EPSG9824">
            <gml:methodName>Transverse Mercator</gml:methodName>
            <gml:methodID>
              <gml:code>9824</gml:code>
            </gml:methodID>
          </gml:OperationMethod>
        </gml:usesMethod>
      </gml:Conversion>
    </gml:definedByConversion>
  </gml:ProjectedCRS >
</gml:dictionaryEntry>

```

```

    <gml:codeSpace>EpSG</gml:codeSpace>
    <gml:version>6.0</gml:version>
  </gml:methodID>
  <gml:methodFormula>

```

The formulas to derive the projected Easting and Northing coordinates are in the form of a series as follows:

Easting, $E = Z \cdot 106 + FE + k_0 \cdot [A + (1 - T + C)A^3/6 + (5 - 18T + T^2 + 72C - 58e^2)A^5/120]$
 Northing, $N = FN + k_0 \{M - MO + nu \cdot \tan(\phi)[A^2/2 + (5 - T + 9C + 4C^2)A^4/24 + (61 - 58T + T^2 + 600C - 330e^2)A^6/720]\}$

where

ϕ is the latitude (measured in radians in this formula)

Z (Zone number) = INT(($\lambda + \lambda_l + W$) / W) with λ (Longitude), λ_l and W in degrees

If λ is negative, $\lambda = (\lambda + 360)$ degrees.

$\lambda_0 = [Z \cdot W] - \lambda_l + (W/2)$

λ_l is the Initial Longitude of the zoned grid system

W is the width of each zone of the zoned grid system

$T = \tan^2(\phi)$

$C = e^2 \cos^2(\phi) / (1 - e^2)$

$A = (\lambda - \lambda_0) \cos(\phi)$, with λ and λ_0 in radians

$\lambda_0 = [Z \cdot W] - [\lambda_l + (W/2)]$

$nu = a / (1 - e^2 \sin^2(\phi))^{0.5}$

$M = a[(1 - e^2/4 - 3e^4/64 - 5e^6/256 - \dots)\phi - (3e^2/8 + 3e^4/32 + 45e^6/1024 + \dots)\sin^2(\phi) + (15e^4/256 + 45e^6/1024 + \dots)\sin^4(\phi) - (35e^6/3072 + \dots)\sin^6(\phi) + \dots]$

with ϕ in radians and M_0 for ϕ_0 , the latitude of the origin, derived in the same way.

```

  </gml:methodFormula>
  <gml:usesParameter xlink:href="#EPSG8801" xlink:title="Latitude of natural origin"/>
  <gml:usesParameter>
    <gml:OperationParameter gml:id="EPSG8830">
      <gml:parameterName>Initial Longitude </gml:parameterName>
      <gml:parameterID>
        <gml:code>8830</gml:code>
        <gml:codeSpace>EPSG</gml:codeSpace>
        <gml:version>6.0</gml:version>
        <gml:remarks>The longitude of the western limit of the first zone of a

```

Transverse Mercator zoned grid system. Denoted by λ_l in the method formula

```

</gml:remarks>

```

```

    </gml:parameterID>
  </gml:OperationParameter>
</gml:usesParameter>
  <gml:usesParameter>
    <gml:OperationParameter gml:id="EPSG8831">
      <gml:parameterName>Zone Width </gml:parameterName>
      <gml:parameterID>
        <gml:code>8831</gml:code>
        <gml:codeSpace>EPSG</gml:codeSpace>
        <gml:version>6.0</gml:version>
        <gml:remarks>The longitude width of a zone of a Transverse Mercator

```

zoned grid system. Denoted by W in the method formula

```

</gml:remarks>

```

```

    </gml:parameterID>
  </gml:OperationParameter>
</gml:usesParameter>
  <gml:usesParameter>
    <gml:OperationParameter gml:id="EPSG8805">
      <gml:parameterName>Scale factor at natural origin</gml:parameterName>
      <gml:parameterID>
        <gml:code>8805</gml:code>
        <gml:codeSpace>EPSG</gml:codeSpace>
        <gml:version>6.0</gml:version>
        <gml:remarks>The factor by which the map grid is reduced or enlarged

```

during the projection process, defined by its value at the natural origin. Denoted by k_0 in the method formula.

```

</gml:remarks>

```

```

    </gml:parameterID>
  </gml:OperationParameter>
</gml:usesParameter>

```

```

    <gml:usesParameter>
      <gml:OperationParameter gml:id="EPSG8806">
        <gml:parameterName>False easting</gml:parameterName>
        <gml:parameterID>
          <gml:code>8806</gml:code>
          <gml:codeSpace>EPSG</gml:codeSpace>
          <gml:version>6.0</gml:version>
          <gml:remarks>Since the natural origin may be at or near the centre of the
projection and under normal coordinate circumstances would thus give rise to negative coordinates over parts of
the mapped area, this origin is usually given false coordinates which are large enough to avoid this inconvenience.
The False Easting is the easting value assigned to the abscissa (east) axis of the projection grid at the natural
origin. Denoted by FE in the method formula.</gml:remarks>
        </gml:parameterID>
      </gml:OperationParameter>
    </gml:usesParameter>
    <gml:usesParameter>
      <gml:OperationParameter gml:id="EPSG8807">
        <gml:parameterName>False Northing</gml:parameterName>
        <gml:parameterID>
          <gml:code>8807</gml:code>
          <gml:codeSpace>EPSG</gml:codeSpace>
          <gml:version>6.0</gml:version>
          <gml:remarks>Since the natural origin may be at or near the centre of the
projection and under normal coordinate circumstances would thus give rise to negative coordinates over parts of
the mapped area, this origin is usually given false coordinates which are large enough to avoid this inconvenience.
The False Northing, FN, is the northing value assigned to the ordinate (north) axis of the projection grid at the
natural origin.</gml:remarks>
        </gml:parameterID>
      </gml:OperationParameter>
    </gml:usesParameter>
    <gml:OperationMethod>
      <gml:usesMethod>
        <gml:usesValue>
          <gml:value uom="urn:x-epsg:v0.1:uom:degree">0.0</gml:value>
          <gml:valueOfParameter xlink:href="#EPSG8801" xlink:title="Latitude of natural origin"/>
        </gml:usesValue>
        <gml:usesValue>
          <gml:value uom="urn:x-epsg:v0.1:uom:degree">-144.0</gml:value>
          <gml:valueOfParameter xlink:href="#EPSG8830" xlink:title="Initial longitude"/>
        </gml:usesValue>
        <gml:usesValue>
          <gml:value uom="urn:x-epsg:v0.1:uom:degree">6.0</gml:value>
          <gml:valueOfParameter xlink:href="#EPSG8831" xlink:title="Zone width"/>
        </gml:usesValue>
        <gml:usesValue>
          <gml:value uom="urn:x-epsg:v0.1:uom:one">0.9996</gml:value>
          <gml:valueOfParameter xlink:href="#EPSG8805" xlink:title="Scale factor"/>
        </gml:usesValue>
        <gml:usesValue>
          <gml:value uom="urn:x-si:v1999:uom:metre">0.0</gml:value>
          <gml:valueOfParameter xlink:href="#EPSG8806" xlink:title="False easting"/>
        </gml:usesValue>
        <gml:usesValue>
          <gml:value uom="urn:x-si:v1999:uom:metre">0.0</gml:value>
          <gml:valueOfParameter xlink:href="#EPSG8807" xlink:title="False northing"/>
        </gml:usesValue>
      </gml:Conversion>
    </gml:definedByConversion>
    <gml:usesCartesianCS xlink:href="#EPSG4400" xlink:title="Cartesian 2D CS"/>
  </gml:ProjectedCRS>
</gml:dictionaryEntry>
</gml:Dictionary>

```

C.3.1 MinimalRootInstance.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<gml:FeatureCollection xmlns="http://www.opengis.org/schema/gml-jp2" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:exp1="http://www.spain.org" xmlns:exp2="http://www.france.org"
xsi:schemaLocation="http://www.opengis.net/gml ../gml4jp2.xsd">
  <!-- All schema location file path references from within a jp2 file will using the urn format:
  urn:jp2k:label003:xsd:
  where "jp2k" represents the namespace authority for this urn, "label003" represents the label ID of the assoc box,
  and "xsd" is the XML file extension of the XML file inside the XMLBox.
  -->
  <gml:description>This GML/JPEG 2000 Root Instance contains a GML coverage description and a GML
  feature descriptions of the geographic features embedded in the image</gml:description>
  <gml:name>Root Instance</gml:name>
  <gml:boundedBy>
    <gml:Null>withheld</gml:Null>
  </gml:boundedBy>
  <gml:featureMember>
    <gml:RectifiedGridCoverage dimension="2" gml:id="RGC0001">
      <gml:rectifiedGridDomain>
        <gml:RectifiedGrid dimension="2">
          <gml:limits>
            <gml:GridEnvelope>
              <gml:low>1 1</gml:low>
              <gml:high>4 4</gml:high>
            </gml:GridEnvelope>
          </gml:limits>
          <gml:axisName>u</gml:axisName>
          <gml:axisName>v</gml:axisName>
          <gml:origin>
            <gml:Point gml:id="P0001" srsName="urn:jp2k:label002:xml:crs:c1123">
              <gml:coordinates>1.2 3.4</gml:coordinates>
            </gml:Point>
          </gml:origin>
          <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">1 2</gml:offsetVector>
          <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">4 5</gml:offsetVector>
        </gml:RectifiedGrid>
      </gml:rectifiedGridDomain>
      <gml:rangeSet>
        <gml:File>
          <gml:rangeParameters>
            <gml:QuantityList uom="urn:jp2k:labelID:xml:uom:code">inapplicable</gml:QuantityList>
          </gml:rangeParameters>
          <gml:fileName>file123.jp2</gml:fileName>
          <gml:fileStructure>Record Interleaved</gml:fileStructure>
        </gml:File>
      </gml:rangeSet>
    </gml:RectifiedGridCoverage>
  </gml:featureMember>
</gml:FeatureCollection>

```

C.4 Sample Application Schemas for Multiple Code Stream

C.4.1 CoverageSchema1.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.spain.org" xmlns:gml="http://www.opengis.net/gml"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:app="http://www.spain.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">

```

```

<import namespace="http://www.opengis.net/gml" schemaLocation="..gml4jp2.xsd"/>
<!-- =====>
<element name="AverageTemp" type="gml:RectifiedGridCoverageType"
substitutionGroup="gml:_Coverage"/>
<!-- =====>
<element name="Temperature" type="gml:MeasureOrNullListType" substitutionGroup="gml:_Value"/>
<!-- =====>
</schema>

```

C.4.2 CoverageSchema2.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.spain.org" xmlns:gml="http://www.opengis.net/gml"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:app="http://www.spain.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">
<import namespace="http://www.opengis.net/gml" schemaLocation="..gml3.0/base/gml.xsd"/>
<!-- =====>
<element name="AveragePressure" type="gml:RectifiedGridCoverageType"
substitutionGroup="gml:_Coverage"/>
<!-- =====>
<element name="Pressure" type="gml:MeasureOrNullListType" substitutionGroup="gml:_Value"/>
</schema>

```

C.4.2 FeatureSchema.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="http://www.france.org" xmlns:gml="http://www.opengis.net/gml"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:app="http://www.france.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">
<import namespace="http://www.opengis.net/gml" schemaLocation="..gml4jp2.xsd"/>
<element name="City" type="app:CityType" substitutionGroup="gml:_FeatureCollection"/>
<complexType name="CityType">
<complexContent>
<extension base="gml:AbstractFeatureCollectionType">
<sequence/>
</extension>
</complexContent>
</complexType>
<!-- =====>
<element name="LandParcel" type="app:LandParcelType" substitutionGroup="gml:_FeatureCollection"/>
<complexType name="LandParcelType">
<complexContent>
<extension base="gml:AbstractFeatureCollectionType">
<sequence>
<element name="numberOfBuildings" type="integer"/>
<element ref="gml:extentOf" minOccurs="0"/>
</sequence>
</extension>
</complexContent>
</complexType>
<!-- =====>
<element name="_Street" type="gml:AbstractFeatureType" abstract="true"
substitutionGroup="gml:_Feature"/>
<element name="Street" type="app:StreetType" substitutionGroup="app:_Street"/>
<complexType name="StreetBaseType">
<complexContent>
<restriction base="gml:AbstractFeatureCollectionType">
<sequence>
<element ref="gml:metaDataProperty" minOccurs="0"/>
<element ref="gml:description" minOccurs="0"/>
<element ref="gml:name" minOccurs="0" maxOccurs="unbounded"/>

```

```

        <element ref="gml:boundedBy"/>
      </sequence>
    </restriction>
  </complexContent>
</complexType>
<!-- =====>
<complexType name="StreetType">
  <complexContent>
    <extension base="app:StreetBaseType">
      <sequence>
        <element name="streetMember" type="app:StreetMemberPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
        <element ref="gml:centerLineOf" minOccurs="0"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<!-- =====>
<complexType name="StreetMemberPropertyType">
  <annotation>
    <documentation>Container for a street or streetSegment - follow gml:AssociationType
pattern.</documentation>
  </annotation>
  <sequence>
    <element ref="app:_Street" minOccurs="0"/>
  </sequence>
  <attributeGroup ref="gml:AssociationAttributeGroup"/>
</complexType>
<!-- =====>
<element name="StreetSegment" type="app:StreetSegmentType" substitutionGroup="app:_Street"/>
<complexType name="StreetSegmentType">
  <complexContent>
    <extension base="gml:AbstractFeatureType">
      <sequence>
        <element name="numberLanes" type="positiveInteger"/>
        <element ref="gml:centerLineOf" minOccurs="0"/>
        <element name="intersects" type="gml:FeaturePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<!-- =====>
</schema>

```

C.5 Sample Instances for Multiple Code Stream

C.5.1 CodeStream1.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<gml:FeatureCollection xmlns="http://www.opengis.org/schema/gml-jp2" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:exp1="http://www.spain.org" xmlns:exp2="http://www.france.org"
xsi:schemaLocation="http://www.opengis.net/gml ../gml3.0/base/gml.xsd http://www.spain.org
CoverageSchema1.xsd http://www.france.org FeatureSchema.xsd">
  <!-- All schema location file path references from within a jp2 file will using the urn format:
urn:jp2k:label003:xsd:
where "jp2k" represents the namespace authority for this urn, "label003" represents the label ID of the assoc box,
and "xsd" is the XML file extension of the XML file inside the XMLBox.
-->
  <gml:description>This GML/JPEG 2000 Instance contains a GML coverage description and GML feature
descriptions of the geographic features associated to codestream 1</gml:description>

```

```

<gml:name>Instance associated to codestream 1</gml:name>
<gml:boundedBy>
  <gml:Null>missing</gml:Null>
</gml:boundedBy>
<gml:featureMember>
  <exp1:AverageTemp dimension="2" gml:id="AT0001">
    <gml:rectifiedGridDomain>
      <gml:RectifiedGrid dimension="2">
        <gml:limits>
          <gml:GridEnvelope>
            <gml:low>1 1</gml:low>
            <gml:high>5 5</gml:high>
          </gml:GridEnvelope>
        </gml:limits>
        <gml:axisName>u</gml:axisName>
        <gml:axisName>v</gml:axisName>
        <gml:origin>
          <gml:Point gml:id="P0001" srsName="urn:jp2k:label002:xml:crs:c1123">
            <gml:coordinates>1.2 3.4</gml:coordinates>
          </gml:Point>
        </gml:origin>
        <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">1 2</gml:offsetVector>
        <gml:offsetVector srsName="urn:jp2k:label002:xml:crs:c1123">4 5</gml:offsetVector>
      </gml:RectifiedGrid>
    </gml:rectifiedGridDomain>
    <gml:rangeSet>
      <gml:File>
        <gml:rangeParameters>
          <exp1:Temperature
uom="urn:jp2k:label002:xml:uom:degC">template</exp1:Temperature>
        </gml:rangeParameters>
        <gml:fileName>file123.jp2</gml:fileName>
        <gml:fileStructure>Record Interleaved</gml:fileStructure>
      </gml:File>
    </gml:rangeSet>
  </exp1:AverageTemp>
</gml:featureMember>
<gml:featureMember xlink:href="urn:jp2k:label002:xml:feature:LP001" xlink:title="LandParcel1"/>
<gml:featureMember xlink:href="urn:jp2k:label002:xml:feature:SS1" xlink:title="Elm St 100 Blck"/>
<gml:featureMember xlink:href="urn:jp2k:label002:xml:feature:SS2" xlink:title="Alder St 100 Blck"/>
</gml:FeatureCollection>

```

C.5.1 CodeStream2.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<gml:FeatureCollection xmlns="http://www.opengis.org/schema/gml-jp2" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:exp1="http://www.spain.org" xmlns:exp2="http://www.france.org"
xsi:schemaLocation="http://www.opengis.net/gml ../gml3.0/base/gml.xsd http://www.spain.org
CoverageSchema2.xsd http://www.france.org FeatureSchema.xsd">
  <!-- All schema location file path references from within a jp2 file will using the urn format:
urn:jp2k:label003:xsd::
where "jp2k" represents the namespace authority for this urn, "label003" represents the label ID of the assoc box,
and "xsd" is the XML file extension of the XML file inside the XMLBox.
-->
  <gml:description>This GML/JPEG 2000 Instance contains a GML coverage description and GML feature
descriptions of the geographic features associated to codestream 2</gml:description>
  <gml:name>Instance associated to codestream 2</gml:name>
  <gml:boundedBy>
    <gml:Null>missing</gml:Null>
  </gml:boundedBy>

```



```

<gml:featureMember>
  <exp1:AveragePressure dimension="2" gml:id="AT0001">
    <gml:rectifiedGridDomain>
      <gml:RectifiedGrid dimension="2">
        <gml:limits>
          <gml:GridEnvelope>
            <gml:low>1 1</gml:low>
            <gml:high>2 2</gml:high>
          </gml:GridEnvelope>
        </gml:limits>
        <gml:axisName>u</gml:axisName>
        <gml:axisName>v</gml:axisName>
        <gml:origin>
          <gml:Point gml:id="P0002" srsName="urn:jp2k:label002.xml:crs:c1123">
            <gml:coordinates>5.6 7.8</gml:coordinates>
          </gml:Point>
        </gml:origin>
        <gml:offsetVector srsName="urn:jp2k:label002.xml:crs:c1123">1 1</gml:offsetVector>
        <gml:offsetVector srsName="urn:jp2k:label002.xml:crs:c1123">2 2</gml:offsetVector>
      </gml:RectifiedGrid>
    </gml:rectifiedGridDomain>
    <gml:rangeSet>
      <gml:File>
        <gml:rangeParameters>
          <exp1:Pressure uom="urn:jp2k:label002.xml:uom:milliBars">template</exp1:Pressure>
        </gml:rangeParameters>
        <gml:fileName>file456.jp</gml:fileName>
        <gml:fileStructure>Record Interleaved</gml:fileStructure>
      </gml:File>
    </gml:rangeSet>
  </exp1:AveragePressure>
</gml:featureMember>
<gml:featureMember xlink:href="urn:jp2k:label002.xml:feature:LP002" xlink:title="LandParcel2"/>
<gml:featureMember xlink:href="urn:jp2k:label002.xml:feature:SS3" xlink:title="Alder St 200 Blck"/>
</gml:FeatureCollection>

```

C.5.1 SharedFeatures.xml

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.4 U (http://www.xmlspy.com) by David S. Burggraf (Galdos Systems Inc.) -->
<gml:FeatureCollection xmlns="http://www.opengis.org/schema/gml-jp2" xmlns:gml="http://www.opengis.net/gml"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:exp2="http://www.france.org" xsi:schemaLocation="http://www.opengis.net/gml ../gml4jp2.xsd
  http://www.france.org FeatureSchema.xsd">
  <gml:description>This instance document contains GML feature descriptions of the geographic features that
  may be referenced from the codestream specific instances.</gml:description>
  <gml:name>Shared Feature Instance</gml:name>
  <gml:boundedBy>
    <gml:Envelope srsName="urn:jp2k:label002.xml:crs:c1123">
      <gml:pos>0 0</gml:pos>
      <gml:pos>150 100</gml:pos>
    </gml:Envelope>
  </gml:boundedBy>
  <gml:featureMembers>
    <exp2:City gml:id="City001">
      <gml:boundedBy>
        <gml:Envelope srsName="urn:jp2k:label002.xml:crs:c1123">
          <gml:pos>0 0</gml:pos>
          <gml:pos>150 100</gml:pos>
        </gml:Envelope>
      </gml:boundedBy>
    </exp2:City>
  </gml:featureMembers>

```

```

<exp2:LandParcel gml:id="LP001">
  <gml:boundedBy>
    <gml:Null>withheld</gml:Null>
  </gml:boundedBy>
  <exp2:numberOfBuildings>1</exp2:numberOfBuildings>
  <gml:extentOf>
    <gml:Polygon srsName="urn:jp2k:label002.xml:crs:c1123">
      <gml:exterior>
        <gml:LinearRing>
          <gml:pos>10.0 50</gml:pos>
          <gml:pos>30 50</gml:pos>
          <gml:pos>30 90</gml:pos>
          <gml:pos>10 90</gml:pos>
          <gml:pos>10 50</gml:pos>
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </gml:extentOf>
</exp2:LandParcel>
<exp2:LandParcel gml:id="LP002">
  <gml:boundedBy>
    <gml:Null>withheld</gml:Null>
  </gml:boundedBy>
  <exp2:numberOfBuildings>1</exp2:numberOfBuildings>
  <gml:extentOf>
    <gml:Polygon gml:id="P2" srsName="urn:jp2k:label002.xml:crs:c1123">
      <gml:exterior>
        <gml:LinearRing>
          <gml:coordinates cs="," ts=" " decimal=".">10.0,10 30,10 30,50 10,50
10,10</gml:coordinates>
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </gml:extentOf>
</exp2:LandParcel>
<exp2:StreetSegment gml:id="SS1">
  <gml:name>Elm Street 100 Block</gml:name>
  <exp2:numberLanes>1</exp2:numberLanes>
  <gml:centerLineOf>
    <gml:LineString gml:id="L1">
      <gml:coordinates>10,10 30,10</gml:coordinates>
    </gml:LineString>
  </gml:centerLineOf>
  <exp2:intersects xlink:href="#SS2"/>
</exp2:StreetSegment>
<exp2:StreetSegment gml:id="SS2">
  <gml:name>Alder Street 100 Block</gml:name>
  <exp2:numberLanes>1</exp2:numberLanes>
  <gml:centerLineOf>
    <gml:LineString gml:id="L2" srsName="urn:jp2k:label002.xml:crs:c1123">
      <gml:coordinates>30,10 30,50</gml:coordinates>
    </gml:LineString>
  </gml:centerLineOf>
  <exp2:intersects xlink:href="#SS1"/>
</exp2:StreetSegment>
<exp2:StreetSegment gml:id="SS3">
  <gml:name>Alder Street 200 Block</gml:name>
  <exp2:numberLanes>1</exp2:numberLanes>
  <gml:centerLineOf>
    <gml:LineString gml:id="L3" srsName="urn:jp2k:label002.xml:crs:c1123">
      <gml:coordinates>30,50 30,90</gml:coordinates>
    </gml:LineString>
  </gml:centerLineOf>
  <exp2:intersects xlink:href="#SS1"/>
</exp2:StreetSegment>

```

```
<exp2:Street gml:id="St1">
  <gml:boundedBy>
    <gml:Null>withheld</gml:Null>
  </gml:boundedBy>
  <exp2:streetMember xlink:href="#SS2"/>
  <exp2:streetMember xlink:href="#SS3"/>
</exp2:Street>
</gml:featureMembers>
</exp2:City>
</gml:featureMembers>
</gml:FeatureCollection>
```


Bibliography