Open Geospatial Consortium

OGC® Testbed 10 Annotations Engineering Report

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Abstract

This OGC Engineering Report provides guidelines for dealing with geospatial annotations in OGC standards. It proposes a generic data model and a set of mappings into different popular encodings This OGC® document is applicable to OWS context, GMLJP2 and any other standards that can require annotations.

Keywords

ogcdoc, ogc documents, ows10, annotations, gmljp2, xima, gml, kml, owc, json

Preface

This Engineering Report documents a component of the OGC Testbed 10 (Testbed-10) that is part of the OGC Interoperability Program (IP). The IP is a global, hands-on collaborative agile prototyping program designed to rapidly develop, test and deliver proven candidate standards into the OGC Standards Program, where they are formalized for public release.

Testbed 10 was organized around the following threads:

Cross-Community Interoperability (CCI): Increase Geospatial community interoperability by building on CCI OWS-9 work in semantic mediation, volunteer geographic information (VGI), provenance and data quality, and Global Gazetteer. Explore the potential of interoperability in the hydrology domain and utilizing ontologies to more easily share and visualize geospatial data.

Open Mobility: Explore the geospatial standards requirements needed to support the growing emerging mobile environment where client applications are mobile, information services are mobile, and increasingly distributed across cloud infrastructures. The Open Mobility thread will address these requirements while leveraging on the work achieved in the OWS-9 Testbed in the areas of Geopackages and Geopackaging services and new OWS Context encodings.

Aviation: Develop and demonstrate the use of the Aeronautical Information Exchange Model (AIXM) and the Flight Information Exchange Model (FIXM), building on the work accomplished in prior testbeds to advance the applications of OGC Web Services

standards in next generation air traffic management systems to support European and US aviation modernization programs.

Annotations activities were part of the Open Mobility thread.

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OGC® Testbed 10 Annotations Engineering Report

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1.1   Scope

This OGC® document gives guidelines for dealing with geospatial annotations in OGC standards. It proposes a generic data model and a set of mappings into different popular encodings

This OGC® document is applicable to OWS context, GMLJP2 and any other standards that can require annotations.

1.2   Document contributor contact points

All questions regarding this document should be directed to the editor or the contributors:

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1.3   Revision history

Date	Release	Editor	Primary clauses modified	Description
19/04/2014	0.0.1	Joan Masó	All	Initial Document
15/05/2014	0.0.2	Joan Masó	All	Complete write
22/05/2014	1.0.0	Raj Singh	All	General review

1.4   Future work

These are some aspects that require a review if this document is further considered in the OGC standardization process: MotivationType was included in the abstract model in the last minute and is not incorporated into the mapping to the encodings. The definition of the abstract annotation model is defined as a UML diagram and ann.xsd XML schema includes the definition of each annotation element. It could be better to have tables in this

document fully describing each element of the abstract annotation model. The XML ann:Annotation needs and extension point. The requirements listed in this document have different targets and need to be in different requirements classes.

Include some other use cases and extend the model to them if needed and include a symbolization language in the model can be aspects that require further consideration. See also more generic future work in Section 8.

1.5   Forward

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

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

2   References

The following documents are referenced in this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

OGC 07-036 Geographic Markup Language, GML 3.2.1, http://portal.opengeospatial.org/files/?artifact_id=20509

In addition to this document, this report includes an XML Schema Document file and some examples as specified in Annex A.

3   Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Standard [OGC 06-121r3] shall apply. In addition, the following terms and definitions apply.

3.1
annotation
any marking on illustrative material for the purpose of clarification [ISO19117]

NOTE   This generic definition of the annotations concept applies here but one of the purposes of this document is clarify the definition an annotation.

4   Conventions

4.1   Abbreviated terms

Some more frequently used abbreviated terms:

UML   Unified Modeling Language

GML   Geographic Markup Language

4.2   UML notation

Most diagrams that appear in this standard are presented using the Unified Modeling Language (UML) static structure diagram, as described in Subclause 5.2 of [OGC 06-121r3].

4.3   Data dictionary tables

The UML model data dictionary is specified herein in a series of tables. The contents of the columns in these tables are described in Table 1.

Table 1 — Contents of data dictionary tables

Column title	Column contents
Names (left column)	Two names for each included parameter or association (or data structure).
	The first name is the UML model attribute or association role name.
	The second name uses the XML encoding capitalization specified in Subclause 11.6.2 of [OGC 06-121r3].
	The name capitalization rules used are specified in Subclause 11.6.2 of [OGC 06-121r3]. Some names in the tables may appear to contain spaces, but no names contain spaces.
Definition (second column)	Specifies the definition of this parameter (omitting un-necessary words such as "a", "the", and "is"). If the parameter value is the identifier of something, not a description or definition, the definition of this parameter should read something like "Identifier of TBD".
Data type and value (third column) or Data type (if are no second items are included in rows of table)	Normally contains two items:
	The mandatory first item is often the data type used for this parameter, using data types appropriate in a UML model, in which this parameter is a named attribute of a UML class. Alternately, the first item can identify the data structure (or class) referenced by this association, and references a separate table used to specify the contents of that class (or data structure).
	The optional second item in the third column of each table should indicate the source of values for this parameter, the alternative values, or other value information, unless the values are quite clear from other listed information.
Multiplicity and use (right or fourth column)	Normally contains two items:
	The mandatory first item specifies the multiplicity and optionality of this

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Column title	Column contents

or
Multiplicity
  (if are no second
  items are included
  in rows of table)
	parameter in this data structure, either "One (mandatory)", "One or more (mandatory)", "Zero or one (optional)", or "Zero or more (optional)".
	
	The second item in the right column of each table should specify how any multiplicity other than "One (mandatory)" shall be used. If that parameter is optional, under what condition(s) shall that parameter be included or not included? If that parameter can be repeated, for what is that parameter repeated?

When the data type used for this parameter, in the third column of such a table, is an enumeration or code list, all the values specified shall be listed, together with the meaning of each value. When this information is extensive, these values and meanings should be specified in a separate table that is referenced in the third column of this table row.

The data type of many parameters, in the third table column, is specified as "Character String type, not empty". In the XML Schema Documents specified herein, these parameters are encoded with the xsd:string type, which does NOT require that these strings not be empty.

5   Annotations overview

The draft W3C Open Annotation data model defines an annotation as a relation between a piece of information (called *body*) and a *target* object made with some *motivation*. Motivations could be *highlighting*, *describing* or *commenting* (see Figure 1). In the case of geospatial annotation, the *body* is an illustrative feature overlapped to a map and anchored to a complete geospatial feature (the *target* object), a part of it, or a spatial region for the *purpose* of making the map presentation more informative. This aim for improving presentation adds the need for a graphical representation of the body and the target and the need for representing a *connector* between them.
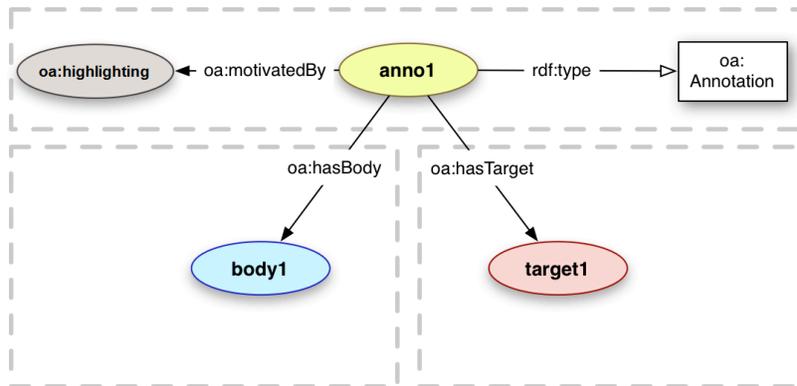
Figure 1 — Open Annotation data model

In OGC, annotations were previously proposed in the XML for Image and Map Annotations (XIMA) discussion paper (http://portal.opengeospatial.org/files/?artifact_id=1020) that was later revised and included in GML in JPEG 2000 for Geographic Imagery (GMLJP2) document (http://portal.opengeospatial.org/files/?artifact_id=13252) in section 7.6, pages: 15-22. XIMA defines annotation as composed by 3 basic elements

- Pointer: A line that links the annotation (called *content* in XIMA) with a region in space that is being annotated (called *annotates* in XIMA).

- Content: A Label that has a text or a picture.

- Annotates: It is the region of the space we are annotating. E.g.: a point or a polygon

These concepts are also the bases for this document even if they get new names and are implemented in a different way. In practice, XIMA was defined as a profile of GML, limiting the geometric capabilities to the minimum required and was included in GMLJP2. This document takes a different approach and defines a generic data model for annotations that is not restricting the geometrical capabilities to define the annotation. The model concepts can then be mapped to common existing encodings other than GML.

5.1   Annotation aspects

Annotations are very similar to features. They can both describe a real phenomenon, they use properties to do that, and some of their properties are geometrical. However, there are some practical differences:

- Annotations are not always required to be geometrically precise (sometimes they are just rectangles or arrows pointing to a rough area).

- Annotations come in small quantities (just a few annotations over a map). This implies that they are not long arrays of instances of a specific feature type.

- Annotations do not require a complex schema with many properties (to have a text, or an image pointing to a geometry can be enough).

- Symbolization of annotations is important, but it is up to clients to present them in different ways, and avoid visual collisions of annotations coming from different sources.

5.2   Use cases

A common use case for annotations is to highlight some element in a georeferenced image or in a map. The annotation is composed of

1. Something identifying a location (point, polygon,...)

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2. Something pointing to that location (not always required)

3. An associated *text* or an image saying something about that location or a descriptive *picture*

An example is the treasure map use case (see Figure 2) where we can clearly see the above mentioned 3 elements.
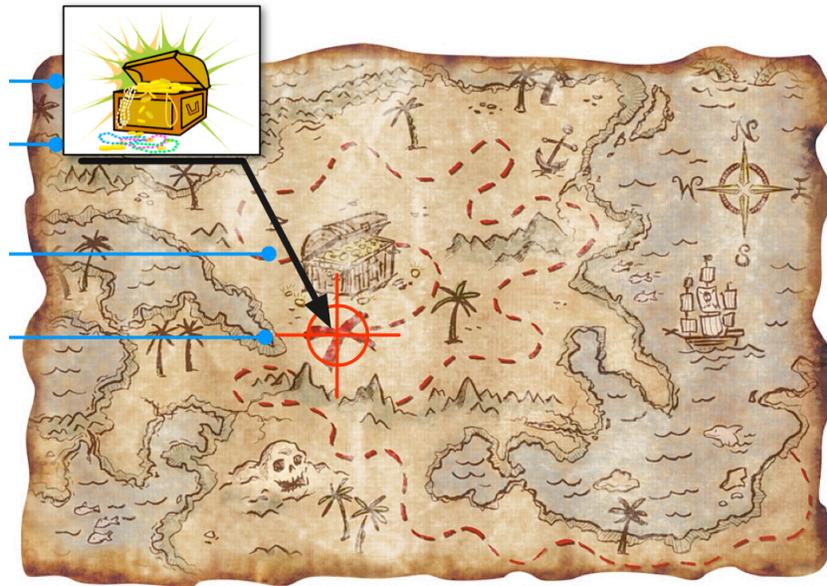
Figure 2 — The treasure map use case

The thing that we want to highlight is not always a point. It is often an area that requires some highlighting via an annotation, hence the need for polygons. This is shown in the refinery use case (see Figure 3).
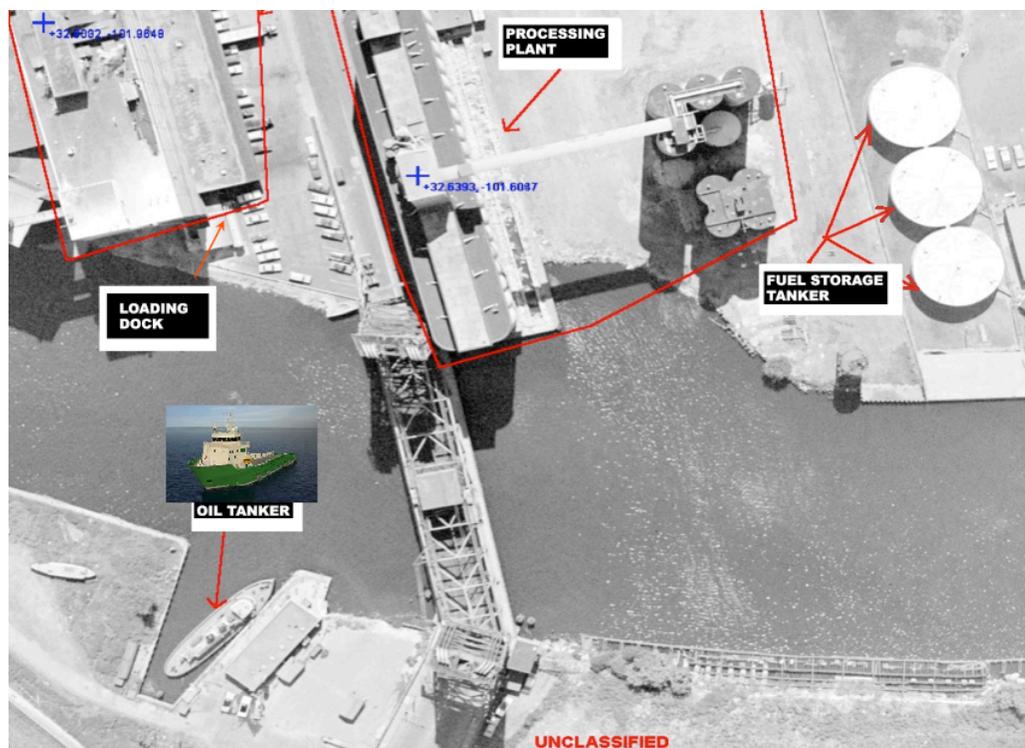
Figure 3 — The refinery use case

6 Annotation abstract data model

Requirement 1: A feature is an annotation if it contains the required elements of the UML model in Figure 4.

An annotation is a feature identified by an *id* that can have *metadata* associated with it and a *motivation*. The annotation annotates something in the real world represented by an *anchor*. The *anchor* (called *target* in the Open Annotation data model) can geometrically be marked in the following ways:

 annotatedFeature: A link to a feature that geographically describes what is annotated.

 location: A geographic object that describes an area being annotated. It does not require that it is precisely defined. The recommended symbology is provided in *locationSym*.

 poi: A point position that represents the object (if the *location* is not a point). Sometimes, when *location* has a line or a polygon geometry, it is useful to have a point that represents it (e.g. in the aviation domain, an airport has a official Airport Reference Point). The recommended symbology is provided in *poiSym* (that can make the coordinates visible). *poi* could also be used to place the *icon*.

If all three values are present, this gives the client the option to represent the geometry of the feature in any one of 3 levels of detail, from a general point location to a precise description of its boundary.

NOTE 1   To annotate an image as a whole, the annotatedFeature points to the corresponding coverage identifier.

An annotation has a *label* (called *body* in the Open Annotation data model) that is annotating the *anchor*. A *connector* is a linear feature that connects both entities. Many times an annotation needs to be more explicit and the *Label* element provides the capability to associate a *text* or an *image* with the purpose of being presented near the *Anchor*.

Requirement 2: A client shall draw the connector (if it exists) from the label area to the border, or the interior of the *location* (ignoring the *poi*).

NOTE 2   We need a way to define the position of the anchor to be able to eventually draw a connector pointing to it. Since the connector is not geometrically described, the anchor element *location* is made mandatory.

NOTE 3   If *location* does not want to be shown, the creating software is encouraged to define *location* as simple as possible (as a single point) and to define a "transparent" *locationSym* .

The connector will be drawn from an area next to the label (from the recommededPos, if provided) to the border or the interior of the location (ignoring the poi, if provided).
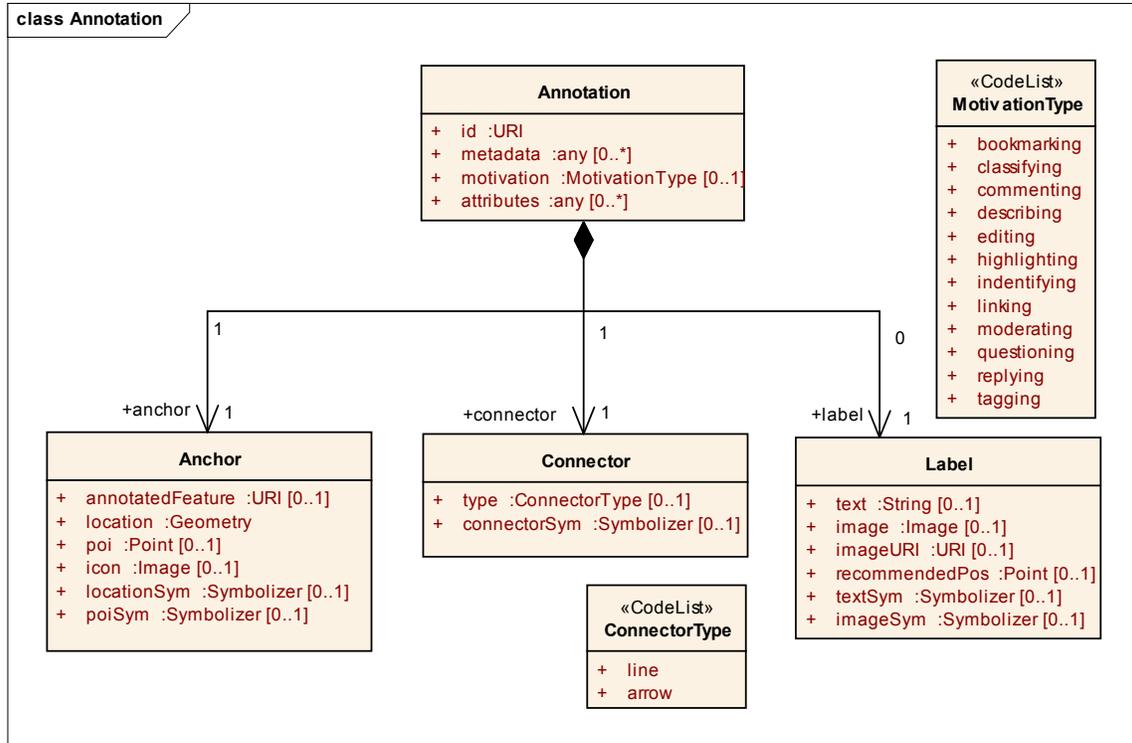
Figure 4 — Annotation abstract UML model

There is a general consensus that a client has to be able to decide how to distribute and place annotations over the map. Interactive clients can allow users to move annotation around the map. Clients that present more than one file containing overlapping annotations and need to be able to avoid collisions and overlaps between them by moving and separating them. They should also be able to change symbolization properties of the annotations to make them more visible. Nevertheless, the capability to provide a default symbolization can be useful. For this reason, the 3 elements of the annotation contain some properties for describing the default symbolization:

☐ Anchor: if *location* is provided, *locationSym* can describe the way the geometry has to be symbolized (e.g. a border color or a fill in pattern for a polygon). If *poi* is provided, *poiSym* can describe the way the point has to be symbolized (e.g. a cross with the coordinates as a text, like in Figure 3). Note that *poiSym* can also describe where to position the *icon*.

☐ Label: if *text* is provided, *textSym* can describe the style of the text (e.g. white text on top of a black background rectangle, like in Figure 3). If *image or imageURI* are provided, *imageSym* can describe the way the image has to be scaled, rotate etc. Both symbolizers can make use of the *recommendedPos* for both the text and the image. In the case that a text and an image are provided at the same time, they are competing for the same area next to *recommendedPos* and the clients have to decide how to place them avoiding overlaps.

☐ Connector: both *type* and *connectorSym* describe the symbology of the connector. *connectorSym* is expected to be a line symbolizer while *type* allow to decide if the connector is a simple *line* of an *arrow* (so it will present an arrow cap). In the absence of *type, line* will be used.

The model is extensible and provides the capability to include any number of additional *attributes* of any kind.

Requirement 3: When the encoding supports it, the annotation coordinates will be expressed in the same CRS as the feature they are annotating. When the selected encoding can reference a different CRS for coordinates, other CRSes are allowed but discouraged.

NOTE: Some encodings have constraints in the CRS that they can represent. For example KML 2.2 only supports long/lat in WGS84. For that reason the CRS requirement above has been left quite open.

NOTE2: The presented annotation model is compatible to the more generic Open Annotation Data Model, Community Draft, 08 February 2013, http://www.openannotation.org/spec/core/

6.1 Consideration of symbolizers

During OWS 10 some alternatives to incorporate a standard symbolization model were studied, including: KML styles, OGC Symbology Encoding (OGC SE), SVG and CSS. Symbology encodings are deeply related to data encodings and can not be easily adapted. Some alternatives have important limitations for annotations such as the impossibility to

associate an icon or an image to a Point feature in OGC SE or the lack of arrow caps in KML.

Another point is to give clients some freedom in representing the annotations. In some cases, clients will have to combine different annotations for the same feature in a single session and automatically avoid position or color collisions.

For these reasons, *Symbolizer* is deliberately not defined in this document and left for future work. Each encoding is expected to have their own capabilities and language to symbolize and clients are expected to adapt to it.

7   Mapping to specific encodings

In this section we are showing how the general model can be mapped into 3 different encodings. The first encoding in GML can be a perfect match to the abstract model because of the intrinsic flexibility in GML. For OWS Context and KML, instead of aiming for a perfect match, we think that is better to map annotation concepts into common OWS context and KML elements.

7.1   Mapping to GML

As said before, this document is taking a different practical route than XIMA approach. We deliberately avoid creating a profile of GML (that chooses a subset of the GML capabilities). Profiles (at least the way XIMA was defined) have problems when you try to mix them in a single application, becoming impossible to validate when they share the same namespace.

Instead, this document is suggesting a set of properties (in a different namespace) that can be used in the definition of GML applications schemas and in conjunction with the geospatial properties that the complete GML provides.

The namespace chosen in this interoperability experiment is:
ann="http://www.opengis.net/annotations/1.0"

The properties are defined in an ann.xsd and they are the same as the ones in the UML model defined in the Figure 4 but defined as independent elements in a way that makes easy to reuse them by means of XML references.

```
<!--Anchor-->
<element name="annotatedFeature" type="ann:FeatureType"/>
<element name="location" type="ann:GeometryType"/>
<element name="poi" type="ann:PoiType"/>
<element name="icon" type="ann:IconType"/>
<element name="locationSym" type="ann:SymbolizedType"/>

 <!--Connector-->
<element name="connectorType" type="ann:ConnectorTypeType"/>
```

```
<element name="connectorSym" type="ann:SymbolizedType"/>

 <!--Label-->
<element name="text" type="ann:TextType"/>
<element name="image" type="ann:ImageType"/>
<element name="recommendedPos" type="ann:RecommendedPosType"/>
<element name="textSym" type="ann:SymbolizedType"/>
<element name="imageSym" type="ann:SymbolizedType"/>
```

The id and the metadata elements in the UML model are mapped to the gml:id and to the gml:metaDataProperty respectively.

For example, let's imagine that we want to define a road feature. In a normal GML application schema, we will do it this way:

```
    <element name="Road" type="xmp:RoadType"
substitutionGroup="gml:AbstractFeature"/>
    <complexType name="RoadType">
        <complexContent>
            <extension base="gml:AbstractFeatureType">
                <sequence>
                    <element name="position" type="gml:CurvePropertyType"/>
                    <element name="width" type="double"/>
                    <element name="name" type="string"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
    <complexType name="RoadPropertyType">
        <sequence minOccurs="0">
            <element ref="xmp:Road"/>
        </sequence>
        <attributeGroup ref="gml:AssociationAttributeGroup"/>
        <attributeGroup ref="gml:OwnershipAttributeGroup"/>
    </complexType>
```

And we will use this application schema to validate a particular road instance like this:

```
        <my_srf:AnnotatedRoad gml:id="ID_ROAD1">
            <my_srf:position>
                <gml:LineString gml:id="ID_ROADPOS1">
                    <gml:pos>300 200</gml:pos>
                    <gml:pos>350 222</gml:pos>
                </gml:LineString>
            </my_srf:position>
            <my_srf:width>4.1</my_srf:width>
            <my_srf:name>M30</my_srf:name>
        </my_srf:AnnotatedRoad>
```

Now we are going to extend the GML definition of a road an create the schema for an annotated road by adding the properties defined in the "ann" namespace:

```xml
<element name="AnnotatedRoad" type="xmp:AnnotatedRoadType"
substitutionGroup="gml:AbstractFeature"/>
    <complexType name="AnnotatedRoadType">
        <complexContent>
            <extension base="gml:AbstractFeatureType">
                <sequence>
                    <!--Anchor-->
                    <element ref="ann:annotatedFeature" minOccurs="0"/>
                    <element ref="ann:location"/>
                    <element ref="ann:poi" minOccurs="0"/>
                    <element ref="ann:icon" minOccurs="0"/>
                    <element ref="ann:locationSym" minOccurs="0"/>
                    <!--Connector-->
                    <element ref="ann:connectorType" minOccurs="0"/>
                    <element ref="ann:connectorSym" minOccurs="0"/>
                    <!--Label-->
                    <element ref="ann:text" minOccurs="0"/>
                    <element ref="ann:image" minOccurs="0"/>
                    <element ref="ann:recommendedPos" minOccurs="0"/>
                    <element ref="ann:textSym" minOccurs="0"/>
                    <element ref="ann:imageSym" minOccurs="0"/>
                    <element name="position" type="gml:CurvePropertyType"/>
                    <element name="width" type="double"/>
                    <element name="name" type="string"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
```

And this way we are able to add an annotation to a road instance:

```xml
<my_srf:RoadCollection gml:id="ID_ROADS1"
xmlns:my_srf="http://www.opengis.net/annotations/1.0/examples/example1"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:ann="http://www.opengis.net/annotations/1.0"
xsi:schemaLocation="http://www.opengis.net/gml/3.2
http://schemas.opengis.net/gml/3.2.1/gml.xsd
http://www.opengis.net/annotations/1.0 ../ann.xsd
http://schemas.opengis.net/annotations/1.0/examples/example1
AnnotatedRoad.xsd">
    <my_srf:road>
        <my_srf:AnnotatedRoad gml:id="ID_ROAD1">
            <ann:annotatedFeature xlink:href="other.xml#1234"/>
            <ann:location>
                <gml:LineString gml:id="ID_LINEROAD1">
                    <gml:pos>300 200</gml:pos>
                    <gml:pos>350 222</gml:pos>
                </gml:LineString>
```

```
            </ann:location>
            <ann:poi>
                <gml:Point gml:id="ID_POIROAD1">
                    <gml:pos>300 200</gml:pos>
                </gml:Point>
            </ann:poi>
            <ann:icon xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.png"/>

            <!--Connector-->
            <ann:connectorType>arrow</ann:connectorType>

            <!--Label-->
            <ann:text>Annotation to the heaven</ann:text>
            <ann:image xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.jpg"/>
            <ann:recommendedPos gml:id="POS1">
                <gml:pos>400 400</gml:pos>
            </ann:recommendedPos>

            <my_srf:position>
                <gml:LineString gml:id="ID_ROADPOS1">
                    <gml:pos>300 200</gml:pos>
                    <gml:pos>350 222</gml:pos>
                </gml:LineString>
            </my_srf:position>
            <my_srf:width>4.1</my_srf:width>
            <my_srf:name>M30</my_srf:name>
        </my_srf:AnnotatedRoad>
    </my_srf:road>
</my_srf:RoadCollection>
```

Annotations do not need complex geometrical definitions but they can require common shapes like points, short lines, coarse polygons, ellipse etc. In fact, ellipses are not defined in the GML schemas. In this XML representation, ann:location is defined as a choice between points, arcs, lines, ellipses and polygons.

```
<complexType name="GeometryType">
    <choice>
        <element ref="gml:Point"/>
        <element ref="gml:LineString"/>
        <element ref="gml:Arc"/>
        <element name="Ellipse" type="ann:EllipseGeometryType"/>
        <element ref="gml:Polygon"/>
    </choice>
</complexType>
```

The definition of ellipse has been added to the ann.xsd XML schema:

```
<complexType name="EllipseGeometryType">
    <annotation>
        <documentation>Inspired in "Best way to define an Ellipse in
GML?" http://www.ogcnetwork.net/node/1033</documentation>
```

```
        </annotation>
        <sequence>
            <element ref="gml:pos"/>
            <element name="semiMajorAxis" type="double"/>
            <element name="semiMinorAxis" type="double"/>
            <element name="orientation" type="double"/>
        </sequence>
    </complexType>
```

Creating a specific application schema for annotations can be complicated and can make interoperability more difficult. An alternative is to use the ann:Annotation object available directly in the in the ann.xsd application schema for a single annotation and the ann:AnnotationCollection for an array of annotations.

```
<ann:AnnotationCollection gml:id="ID_ROADS1"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:ann="http://www.opengis.net/annotations/1.0">
    <ann:annotation>
        <ann:Annotation gml:id="ID_ROAD1">
            <ann:location>
                <gml:LineString gml:id="ID_LINEROAD1">
                    <gml:pos>300 200</gml:pos>
                    <gml:pos>350 222</gml:pos>
                </gml:LineString>
            </ann:location>

            <!--Label-->
            <ann:text>Annotation to the heaven</ann:text>
        </ann:Annotation>
    </ann:annotation>
</ann:AnnotationCollection>
```

Additionally an ann:StructuredAnnotation class is also provided. The later has been added to mimic the UML model completely. However, we believe there is no need to apply such a tree complex structure to describe annotation and recommends the ann:Annotation class.

The complete schemas and examples can be found in the Annex A.

Requirement 4: An annotation encoded in GML shall use the elements defined in the ann.xsd provided in the Annex A of this document.

7.1.1 Using the GML mapping into GMLJP2 v2

At the time of writing this document the GMLJP2 v2 is in the final stages and it is almost ready for its final release as a new OGC standard. The GMLJP2 v1 standard has been reviewed, and in the version 2 it uses GMLCOV but removes the XIMA approach.

GMLCOV has been used to include the GML description of coverages in the JPEG2000 file. The standard adds placeholders for other features and annotations. Nevertheless, no specific annotation encoding is provided or suggested. The proposed annotation schema ann.xsd can be used in conjunction to GMLJP2 proposal to include annotations in a JPEG2000.

The following XML fragment illustrates

```
<?xml version="1.0" encoding="UTF-8"?>
<gmljp2:GMLJP2CoverageCollection gml:id="ID_JPEG2000_0"
          xmlns="http://www.opengis.net/gml/3.2"
          xmlns:gmljp2="http://www.opengis.net/gmljp2/2.0"
          xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
          xsi:schemaLocation="http://www.opengis.net/gmljp2/2.0
../gmlJP2.xsd">
   <boundedBy/>
   <domainSet/>
   <rangeSet/>
   <gmlcov:rangeType/>
   <gmljp2:featureMember>
       <gmljp2:GMLJP2RectifiedGridCoverage gml:id="ID_1">
          <domainSet/>
          <rangeSet/>
          <gmlcov:rangeType/>
          <gmljp2:annotation>
             <ann:Annotation gml:id="AN001"
xmlns:ann="http://www.opengis.net/annotations/1.0" xsi:schemaLocation="
http://www.opengis.net/annotations/1.0
http://shcemas.opengis.net/annotations/1.0/ann.xsd">
                <ann:location>
                   <gml:LineString gml:id="ID_LINEROAD1">
                      <gml:pos>300 200</gml:pos>
                      <gml:pos>350 222</gml:pos>
                   </gml:LineString>
                </ann:location>
                <ann:text>Annotation to the heaven</ann:text>
             <ann:Annotation>
          </gmljp2:annotation>
       </gmljp2:GMLJP2RectifiedGridCoverage>
   </gmljp2:featureMember>
<gmljp2:GMLJP2CoverageCollection>
```

Requirement 5: A GMLJP2 document that contains annotation shall use the elements defined in the ann.xsd and provided in the Annex A and define annotations in the <gmljp2:annotation> elements provided by the GMLJ2 standard schemas. When no annotatedFeature reference is provided, it is assume that the annotation is annotating the parent coverage.

7.2 **Mapping to OWS Context Atom encoding**

There is a temptation to reuse the same GML encoding to include annotations in the owc:content section of an atom:entry of a OWS Context document. Even though this could be syntactically correct, we believe it makes more sense to map the annotation concepts and elements to the common elements of an atom:entry of the OWS Context atom:feed document. Table 2 provides the mapping between the abstract UML model for annotations and a atom:entry element.

Requirement 6: An OWS Context atom:entry is an annotation if it follows the mapping in Table 2.

Table 2 — Mapping to Atom encoding

Names: Annotation OWS Context mapping	Definition	Data type and value	Multiplicity and use

id
`atom:entry/`
`  atom:id`
	An unambiguous reference to the identification of the annotation (IRI)	URI	One [a] (mandatory)

metadata
`atom:entry/`
`  atom:link[@rel="via"]`
	A reference to a metadata about the annotation.	atom:link type.
		@rel shall be "via"
		(e.g. metadata document from which the metadata of the resource is derived).
			Zero or more (optional)

motivation
`atom:feed/`
`  atom:category`
`  [@scheme='http://www.o`
`  pengis.net/`
`  spec/annotation/motiva`
`  tion']`
`  \@term`
	This element marks this entry as an annotation.	Value SHALL be one of the MotivationType possible values.	Zero or one (optional)

annotatedFeature
`atom:entry/`
`  atom:link[@rel="relate`
`d"]/@href"`
	A reference to a feature that is being annotated.	atom:link type.
		@rel shall be "related"[c]
			Zero or more (optional) [b]

location
`atom:entry/`
`  georss:where`
	The spatial extent or scope of the annotation.	*georss:where* element	Zero or one (optional)

poi *(no equivalence in OWC)*	A point inside the extent of the annotation.	*georss:point* element	Zero or one (optional)

icon
`atom:entry/`
`  atom:link[@rel="icon"]`
	An icon representing the place being annotated.	*atom:link* type.
		@rel shall be "icon"
		The attributes length
			Zero or one (optional)

Names: Annotation OWS Context mapping	Definition	Data type and value	Multiplicity and use
		and type SHOULD be provided	

text
`atom:entry/`
`  atom:content`
	A textual label that annotates the feature position	Character String type, not empty
		
		The use of *atom:content* with *@type* equal to "html" is recommended.
			One (mandatory) [d]

imageURI
`atom:entry/`
`  atom:link[`
`  @rel="enclosure"]`
	A image label that annotates the feature position	*atom:link* type.
		
		@rel shall be "enclosure"
		
		@type shall be and image format [e]
			Zero or one (optional)

None
`atom:feed/`
`  atom:category`
`  [@scheme='http://www.o`
`pengis.net/`
`spec/annotation']`
`  \@term`
	This element marks this entry as an annotation.	Value SHALL be "annotation".	Zero or one (optional) but SHOULD be used to help clients to identify these entries

attributes	Any other element	Any (outside of the atom or owc namespace)	Zero or more (optional)

[a] URIs used as identifiers should be in canonical form, as described by section 6 of RFC-3986. Avoid the use of URI like http://server.com/path that should be written as http://server.com/path/

[b] In the absence of if it is assumed that the annotation annotates the whole atom feed

[c] It can be a URI of an external feature in a GML file (e.g. href="http://server.net/gml.xml#facility01" or a reference to another entry in the same atom feed (e.g. href="#tag:example.org,2003:3.2397")

[d] It is defined mandatory because OGC 12-084 requires it. Also remember that `atom:entry/atom:title` and `atom:entry/atom:updated` are also OWS Context Atom mandatory elements.

[e] Including the image directly in `atom:entry/atom:content` combined with the title is also a valid alternative. If you opt for `atom:entry/atom:link[@rel="enclosure"]`, and because it describes a resource potentially large in size and might require special handling, the length and type attribute SHOULD be provided.

The OWS Context document can also contain the full description of a feature or a coverage that is being annotated in another entry or can transport annotations that annotates external features.

Requirement 7: When the annotation entry is annotating another entry of the same Atom feed, the annotation entry shall point to the annotated feature using a `atom:entry/atom:link` with `rel="related"` and `href="#{entry_id}"`, where `{entry_id}` is the `atom:entry/atom:id` of the annotated entry.

7.3   Mapping to KML

Mapping the model to KML requires an additional effort of imagination because KML objects are very limited in the number of properties they have. Fortunately, the concept of KML *folder* allows us for grouping some KML objects in a single box, making possible to generate a more complete structure inside a *folder* that can transport and pack the different elements of the annotation.

Next we will describe a KML structure that maps well with the abstract UML model for annotations shown in Figure 4. This is the way we represent the different elements of an annotation:

- <Style>s are used to express the annotation *Symbolizers*. In fact, we use 3 different <Style> id's: "anchor", "connector" and "label" for the different needed symbolizers in an annotation. You can use variants of these names if you require different symbolization for different annotations in a single KML file.

- <Folder> encapsulates a single annotation. "id" and "atom:link" are used to express the annotation *id* and the annotation *metadata*.

  o <Placemark>s can be used to represent several elements in the annotation such as: *location*, *poi*, *icon*, *connector*, *text*, and *recommendedPos*. Note that *annotatedFeature* is the "atom:link" of the first <Placemark>. Also note that only one *Placemark/Point* element can have a *name* because the text in the name is automatically shown as a label in some KML viewers.

  o <GroundOverlay> is used to show and label *image*.

The following simplified KML template shows how these annotation elements can be combined in a single KML file.

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gx="http://www.google.com/kml/ext/2.2"
xmlns:kml="http://www.opengis.net/kml/2.2"
xmlns:atom="http://www.w3.org/2005/Atom">
   <Document>
      <name>Annotation example: Barcelona</name>
      <Style id="anchor">
         <!--Style for the anchor: locationSym and poiSym (including
icon) -->
      </Style>
      <Style id="connector">
         <!--Style for the connetor: connectorSym -->
      </Style>
      <Style id="label">
         <!--Style for the label: textSym and imageSym -->
      </Style>
```

```
    <Folder id="ID_204">
        <open>0</open>
        <atom:link href="http://metadata.usgs.gov/barcelona"
rel="via"/>
        <Placemark>
            <name>location</name>
            <atom:link href="http://features.server.org/gml#id"
rel="related"/>
            <styleUrl>#anchor</styleUrl>
            <!-- location geometry -->
        </Placemark>
        <Placemark>
            <styleUrl>#anchor</styleUrl>
            <Point><!-- poi coordinate --></Point>
        </Placemark>
        <Placemark>
            <name>Connector</name>
            <styleUrl>#connector</styleUrl>
            <!-- connector line geometry -->
        </Placemark>
        <Placemark>
            <name>ConnectorArrowCap</name>
            <styleUrl>#connector</styleUrl>
            <!-- connector arrowcap geometry if 'type' is 'arrow' -->
        </Placemark>
        <Placemark>
            <name><!-- label 'text' --></name>
            <styleUrl>#label</styleUrl>
            <Point><!-- recommentedPos coordinate --></Point>
        </Placemark>
        <GroundOverlay>
            <Icon><!-- imageURI --></Icon>
        </GroundOverlay>
    </Folder>
  </Document>
</kml>
```

NOTE: We have observed some discrepancies in between Google Earth and Google maps representation of the same KML file. The most significant one is that *name* text is shown as an overlapped text in Google Earth but is not shown in Google Maps.

Requirement 8: A KML document that contains annotations shall use the KML structure presented above and fully exemplified in the Annex B.

Figure 5 shows how Annex B example is presented in Google Earth. The three main elements of an annotation are clearly seen:

☐ The *anchor* is represented both by a green polygon and a square icon.

☐ The *connector* is represented by a red arrow

☐ The *label* is seen as a text and image and an icon.
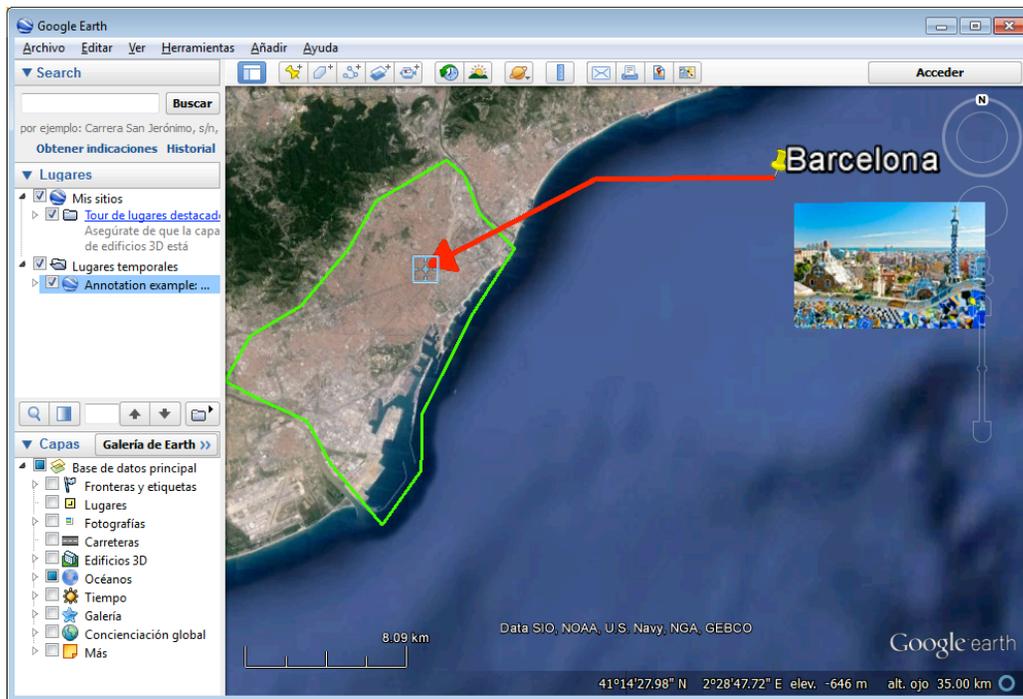
Figure 5 — Google Earth shows an annotation example

8 Future work

These are aspects that have been identified as requiring future work:

☐ Open Annotation Data Model W3C Community draft was taken into account in the abstract UML model for annotations but more work can be done in this direction.

☐ Reexamine the symbolization encodings and add a solution to the abstract model. Consider adopting OGC SE and send a CR to OGC SE when needed, or adopt W3C CSS3 to better align with the larger software marketplace.

☐ Implement the mappings in integrated clients and demonstrate the degree of interoperability of the presented annotation model.

☐ Test the annotation model in GMLJP2 implementations and suggest it as an extension to GMLJP2.

☐ Include mappings to other encodings such as OWS Context JSON. Suggest this model to the OWS Context SWG to explore how the SWG can endorse it.

Annex A

Annotations XML schema and example

A.1 General

This Annex provides additional information related to the Section 7.1. In particular, it provides the full version of the annotation application schema, an XML example that used directly it to generate annotations, an example of a GML application schema that includes elements of the annotation application schema and an example of a GML instance based on the GML application schema example.

A.2   Annotation application schema

This is the full application schema ann.xsd.

```xml
<?xml version="1.0" encoding="windows-1252"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:ann="http://www.opengis.net/annotations/1.0"
targetNamespace="http://www.opengis.net/annotations/1.0"
elementFormDefault="qualified" version="1.0">
   <import namespace="http://www.w3.org/1999/xlink"
schemaLocation="../../xlink/1.0.0/xlinks.xsd"/>
   <import namespace="http://www.opengis.net/gml/3.2"
schemaLocation="../../gml/3.2.1/gml.xsd"/>

   <!--Anchor-->
   <element name="annotatedFeature" type="ann:FeatureType"/>
   <element name="location" type="ann:GeometryType"/>
   <element name="poi" type="ann:PoiType"/>
   <element name="icon" type="ann:IconType"/>
   <element name="locationSym" type="ann:SymbolizedType"/>

   <element name="anchor" type="ann:AnchorPropertyType"/>
   <complexType name="AnchorPropertyType">
      <sequence>
         <element ref="ann:Anchor"/>
      </sequence>
   </complexType>
   <element name="Anchor" type="ann:AnchorType"/>

   <complexType name="AnchorType">
      <sequence>
         <element ref="ann:annotatedFeature" minOccurs="0"/>
         <element ref="ann:location"/>
         <element ref="ann:poi"  minOccurs="0"/>
         <element ref="ann:icon" minOccurs="0"/>
```

```xml
        <element ref="ann:locationSym" minOccurs="0"/>
    </sequence>
</complexType>

 <!--Connector-->
<element name="connectorType" type="ann:ConnectorTypeType"/>
<element name="connectorSym" type="ann:SymbolizedType"/>

<element name="connector" type="ann:ConnectorPropertyType"/>
<complexType name="ConnectorPropertyType">
    <sequence>
        <element ref="ann:Connector"/>
    </sequence>
</complexType>
<element name="Connector" type="ann:ConnectorType"/>

<complexType name="ConnectorType">
    <sequence>
        <element ref="ann:connectorType" minOccurs="0"/>
        <element ref="ann:connectorSym" minOccurs="0"/>
    </sequence>
</complexType>

 <!--Label-->
<element name="text" type="ann:TextType"/>
<element name="image" type="ann:ImageType"/>
<element name="recommendedPos" type="ann:RecommendedPosType"/>
<element name="textSym" type="ann:SymbolizedType"/>
<element name="imageSym" type="ann:SymbolizedType"/>

<element name="label" type="ann:LabelPropertyType"/>
<complexType name="LabelPropertyType">
    <sequence>
        <element ref="ann:Label"/>
    </sequence>
</complexType>
<element name="Label" type="ann:LabelType"/>

<complexType name="LabelType">
    <sequence>
        <element ref="ann:text" minOccurs="0"/>
        <element ref="ann:image" minOccurs="0"/>
        <element ref="ann:recommendedPos" minOccurs="0"/>
        <element ref="ann:textSym" minOccurs="0"/>
        <element ref="ann:imageSym" minOccurs="0"/>
    </sequence>
</complexType>


<simpleType name="TextType">
    <annotation>
        <documentation>Text to be presented on the screen next to the
feature</documentation>
    </annotation>
    <restriction base="string"/>
```

```xml
        </simpleType>

    <complexType name="ImageType"  mixed="true">
        <annotation>
            <documentation>Image to be presented on the screen next to
the feature; probably a picture</documentation>
        </annotation>
        <sequence>
            <any namespace="##other" processContents="lax" minOccurs="0"
maxOccurs="unbounded"/>
        </sequence>
        <attributeGroup ref="xlink:simpleLink"/>
    </complexType>

    <complexType name="IconType">
        <annotation>
            <documentation>Icon pointing to the feature center position
such as a pin</documentation>
        </annotation>
        <sequence>
            <any namespace="##other" processContents="lax" minOccurs="0"
maxOccurs="unbounded"/>
        </sequence>
        <attributeGroup ref="xlink:simpleLink"/>
    </complexType>

    <complexType name="FeatureType">
        <annotation>
            <documentation>A feature id that is being annotated by this
one</documentation>
        </annotation>
        <attributeGroup ref="xlink:simpleLink"/>
    </complexType>

    <simpleType name="ConnectorTypeCodeType">
        <restriction base="string">
            <enumeration value="line"/>
            <enumeration value="arrow"/>
        </restriction>
    </simpleType>
    <simpleType name="ConnectorTypeType">
        <annotation>
            <documentation>A code describing the arrow and its cap. The
arrow connects the text or the image to the center of the
feature</documentation>
        </annotation>
        <union memberTypes="ann:ConnectorTypeCodeType string"/>
    </simpleType>

    <complexType name="RecommendedPosType">
        <annotation>
            <documentation>Last or recommended position of the text
and/or image</documentation>
        </annotation>
        <complexContent>
            <extension base="gml:PointType"/>
```

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```
            </complexContent>
        </complexType>

        <complexType name="SymbolizedType">
            <annotation>
                <documentation>Generic Symbolizer</documentation>
            </annotation>
            <sequence>
                <any namespace="##other" processContents="lax" minOccurs="0"
maxOccurs="unbounded"/>
            </sequence>
            <attribute name="href" type="anyURI"/>
        </complexType>

        <!--
================================================================================
        Generic annotation for direct use without speciifc application
schema
================================================================================
=-->
        <element name="AnnotationCollection"
type="ann:AnnotationCollectionType"
substitutionGroup="gml:AbstractFeature"/>
        <complexType name="AnnotationCollectionType">
            <complexContent>
                <extension base="gml:AbstractFeatureType">
                    <choice  minOccurs="0" maxOccurs="unbounded">
                        <element name="annotation"
type="ann:AnnotationPropertyType"/>
                        <element name="structuredAnnotation"
type="ann:StructuredAnnotationPropertyType"/>
                    </choice>
                </extension>
            </complexContent>
        </complexType>
        <complexType name="AnnotationCollectionPropertyType">
            <sequence minOccurs="0">
                <element ref="ann:AnnotationCollection"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
            <attributeGroup ref="gml:OwnershipAttributeGroup"/>
        </complexType>

        <element name="StructuredAnnotation"
type="ann:StructuredAnnotationType"
substitutionGroup="gml:AbstractFeature"/>
        <complexType name="StructuredAnnotationType">
            <complexContent>
                <extension base="gml:AbstractFeatureType">
                    <sequence>
                        <element name="anchor" type="ann:AnchorPropertyType"/>
                        <element name="connector"
type="ann:ConnectorPropertyType"/>
                        <element name="label" type="ann:LabelPropertyType"/>
                    </sequence>
```

```xml
                </extension>
            </complexContent>
        </complexType>
        <complexType name="StructuredAnnotationPropertyType">
            <sequence minOccurs="0">
                <element ref="ann:StructuredAnnotation"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
            <attributeGroup ref="gml:OwnershipAttributeGroup"/>
        </complexType>

        <element name="Annotation" type="ann:AnnotationType"
substitutionGroup="gml:AbstractFeature"/>
        <complexType name="AnnotationType">
            <complexContent>
                <extension base="gml:AbstractFeatureType">
                    <sequence>
                        <!--Anchor-->
                        <element ref="ann:annotatedFeature" minOccurs="0"/>
                        <element ref="ann:location"/>
                        <element ref="ann:poi"  minOccurs="0"/>
                        <element ref="ann:icon" minOccurs="0"/>
                        <element ref="ann:locationSym" minOccurs="0"/>

                        <!--Connector-->
                        <element ref="ann:connectorType" minOccurs="0"/>
                        <element ref="ann:connectorSym" minOccurs="0"/>

                        <!--Label-->
                        <element ref="ann:text" minOccurs="0"/>
                        <element ref="ann:image" minOccurs="0"/>
                        <element ref="ann:recommendedPos" minOccurs="0"/>
                        <element ref="ann:textSym" minOccurs="0"/>
                        <element ref="ann:imageSym" minOccurs="0"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <complexType name="AnnotationPropertyType">
            <sequence minOccurs="0">
                <element ref="ann:Annotation"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
            <attributeGroup ref="gml:OwnershipAttributeGroup"/>
        </complexType>

        <complexType name="PoiType">
            <sequence>
                <element ref="gml:Point"/>
            </sequence>
        </complexType>
        <complexType name="GeometryType">
            <choice>
                <element ref="gml:Point"/>
                <element ref="gml:LineString"/>
                <element ref="gml:Arc"/>
```

```
            <element name="Ellipse" type="ann:EllipseGeometryType"/>
            <element ref="gml:Polygon"/>
        </choice>
    </complexType>
    <complexType name="EllipseGeometryType">
        <annotation>
            <documentation>Inspired in "Best way to define an Ellipse in
GML?" http://www.ogcnetwork.net/node/1033</documentation>
        </annotation>
        <sequence>
            <element ref="gml:pos">
                <annotation>
                    <documentation>The gml:pos element indicates the
position of the center, or origin, of the ellipse. </documentation>
                </annotation>
            </element>
            <element name="semiMajorAxis" type="double">
                <annotation>
                    <documentation>The gs:semiMajorAxis and
gs:semiMinorAxis elements are the length of the semi-major and semi-
minor axes respectively.</documentation>
                </annotation>
            </element>
            <element name="semiMinorAxis" type="double">
                <annotation>
                    <documentation>The gs:semiMajorAxis and
gs:semiMinorAxis elements are the length of the semi-major and semi-
minor axes respectively.</documentation>
                </annotation>
            </element>
            <element name="orientation" type="double">
                <annotation>
                    <documentation>The gs:orientation element is the angle
by which the semi-major axis is rotated from the first axis of the CRS
towards the second axis. For WGS 84, the orientation indicates rotation
from Northing to Easting, which, if specified in degrees, is roughly
equivalent to a compass bearing (if magnetic north were the same as the
WGS Nnorth pPole).
</documentation>
                </annotation>
            </element>
        </sequence>
    </complexType>
</schema>
```

A.3   Direct use example

This is an XML instance that uses the ann.xsd and contains two annotations using the flat annotation alternative and the structured annotation alternative.

```xml
<ann:AnnotationCollection gml:id="ID_ROADS1"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:ann="http://www.opengis.net/annotations/1.0"
xsi:schemaLocation="http://www.opengis.net/gml/3.2
../../../gml/3.2.1/gml.xsd http://www.opengis.net/annotations/1.0
../ann.xsd">
   <ann:annotation>
      <ann:Annotation gml:id="ID_ROAD1">
         <!--Anchor-->
         <ann:annotatedFeature xlink:href="other.xml#1234"/>
         <ann:location>
            <gml:LineString gml:id="ID_LINEROAD1">
               <gml:pos>300 200</gml:pos>
               <gml:pos>350 222</gml:pos>
            </gml:LineString>
         </ann:location>
         <ann:poi>
            <gml:Point gml:id="ID_POIROAD1">
               <gml:pos>300 200</gml:pos>
            </gml:Point>
         </ann:poi>
         <ann:icon xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.png"/>

         <!--Connector-->
         <ann:connectorType>arrow</ann:connectorType>

         <!--Label-->
         <ann:text>Annotation to the heaven</ann:text>
         <ann:image xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.jpg"/>
         <ann:recommendedPos gml:id="POS1">
            <gml:pos>400 400</gml:pos>
         </ann:recommendedPos>
      </ann:Annotation>
   </ann:annotation>
   <ann:structuredAnnotation>
      <ann:StructuredAnnotation gml:id="ID_ROAD2">
         <ann:anchor>
            <ann:Anchor>
               <ann:annotatedFeature xlink:href="other.xml#1234"/>
               <ann:location>
                  <gml:LineString gml:id="ID_LINEROAD2">
                     <gml:pos>300 200</gml:pos>
                     <gml:pos>350 222</gml:pos>
                  </gml:LineString>
               </ann:location>
               <ann:poi>
                  <gml:Point gml:id="ID_POIROAD2">
                     <gml:pos>300 200</gml:pos>
                  </gml:Point>
               </ann:poi>
               <ann:icon xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.png"/>
```

```
                    </ann:Anchor>
                </ann:anchor>
                <ann:connector>
                    <ann:Connector>
                        <ann:connectorType>arrow</ann:connectorType>
                    </ann:Connector>
                </ann:connector>
                <ann:label>
                    <ann:Label>
                        <ann:text>Annotation to the heaven</ann:text>
                        <ann:image xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.jpg"/>
                        <ann:recommendedPos gml:id="POS2">
                            <gml:pos>400 400</gml:pos>
                        </ann:recommendedPos>
                    </ann:Label>
                </ann:label>
            </ann:StructuredAnnotation>
        </ann:structuredAnnotation>
</ann:AnnotationCollection>
```

A.4 GML application schema using annotations schema

This is an example of GML application schema that uses the ann.xsd and the GML schemas to include some annotation properties and some GML properties in the definition of a annotated road feature type.

```
<?xml version="1.0" encoding="windows-1252"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:ann="http://www.opengis.net/annotations/1.0"
xmlns:xmp="http://www.opengis.net/annotations/1.0/examples/example1"
targetNamespace="http://www.opengis.net/annotations/1.0/examples/exampl
e1" elementFormDefault="qualified" version="1.0">
    <import namespace="http://www.opengis.net/gml/3.2"
schemaLocation="../../../gml/3.2.1/gml.xsd"/>
    <import namespace="http://www.opengis.net/annotations/1.0"
schemaLocation="../ann.xsd"/>

    <element name="RoadCollection" type="xmp:RoadCollectionType"
substitutionGroup="gml:AbstractFeature"/>
    <complexType name="RoadCollectionType">
        <complexContent>
            <extension base="gml:AbstractFeatureType">
                <sequence>
                    <element name="road"
type="xmp:AnnotatedRoadPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
```

```xml
    <complexType name="RoadCollectionPropertyType">
        <sequence minOccurs="0">
            <element ref="xmp:RoadCollection"/>
        </sequence>
        <attributeGroup ref="gml:AssociationAttributeGroup"/>
        <attributeGroup ref="gml:OwnershipAttributeGroup"/>
    </complexType>
    <element name="AnnotatedRoad" type="xmp:AnnotatedRoadType"
substitutionGroup="gml:AbstractFeature"/>
    <complexType name="AnnotatedRoadType">
        <complexContent>
            <extension base="gml:AbstractFeatureType">
                <sequence>
                    <!--Anchor-->
                    <element ref="ann:annotatedFeature" minOccurs="0"/>
                    <element ref="ann:location"/>
                    <element ref="ann:poi" minOccurs="0"/>
                    <element ref="ann:icon" minOccurs="0"/>
                    <element ref="ann:locationSym" minOccurs="0"/>
                    <!--Connector-->
                    <element ref="ann:connectorType" minOccurs="0"/>
                    <element ref="ann:connectorSym" minOccurs="0"/>
                    <!--Label-->
                    <element ref="ann:text" minOccurs="0"/>
                    <element ref="ann:image" minOccurs="0"/>
                    <element ref="ann:recommendedPos" minOccurs="0"/>
                    <element ref="ann:textSym" minOccurs="0"/>
                    <element ref="ann:imageSym" minOccurs="0"/>
                    <element name="position" type="gml:CurvePropertyType"/>
                    <element name="width" type="double"/>
                    <element name="name" type="string"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
    <complexType name="AnnotatedRoadPropertyType">
        <sequence minOccurs="0">
            <element ref="xmp:AnnotatedRoad"/>
        </sequence>
        <attributeGroup ref="gml:AssociationAttributeGroup"/>
        <attributeGroup ref="gml:OwnershipAttributeGroup"/>
    </complexType>
</schema>
```

A.5   GML features using annotation schema.

This GML instance uses the previous application schema to define an annotated road feature.

```xml
<my_srf:RoadCollection gml:id="ID_ROADS1"
xmlns:my_srf="http://www.opengis.net/annotations/1.0/examples/example1"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:ann="http://www.opengis.net/annotations/1.0"
xsi:schemaLocation="http://www.opengis.net/gml/3.2
../../../gml/3.2.1/gml.xsd http://www.opengis.net/annotations/1.0
../ann.xsd http://www.opengis.net/annotations/1.0/examples/example1
AnnotatedRoad.xsd">
    <my_srf:road>
        <my_srf:AnnotatedRoad gml:id="ID_ROAD1">
            <ann:annotatedFeature xlink:href="other.xml#1234"/>
            <ann:location>
                <gml:LineString gml:id="ID_LINEROAD1">
                    <gml:pos>300 200</gml:pos>
                    <gml:pos>350 222</gml:pos>
                </gml:LineString>
            </ann:location>
            <ann:poi>
                <gml:Point gml:id="ID_POIROAD1">
                    <gml:pos>300 200</gml:pos>
                </gml:Point>
            </ann:poi>
            <ann:icon xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.png"/>

            <!--Connector-->
            <ann:connectorType>arrow</ann:connectorType>

            <!--Label-->
            <ann:text>Annotation to the heaven</ann:text>
            <ann:image xlink:href="http://www.diakonima.gr/wp-
content/uploads/2009/06/road_to_heaven_this_one1.jpg"/>
            <ann:recommendedPos gml:id="POS1">
                <gml:pos>400 400</gml:pos>
            </ann:recommendedPos>
            <my_srf:position>
                <gml:LineString gml:id="ID_ROADPOS1">
                    <gml:pos>300 200</gml:pos>
                    <gml:pos>350 222</gml:pos>
                </gml:LineString>
            </my_srf:position>
            <my_srf:width>4.1</my_srf:width>
            <my_srf:name>M30</my_srf:name>
        </my_srf:AnnotatedRoad>
    </my_srf:road>
</my_srf:RoadCollection>
```

Annex B

KML annotation example

B.1 General

The mapping between the annotation abstract data model and KML is explained in Subsection 7.3. This Annex includes a full KML document that illustrates all the aspects of the model and honors the proposed structure for annotations in KML. The KML includes an anchor a connector and a label. It marks Barcelona city with a polygon (anchor) and icon (anchor), an arrow (connector), a text and a picture (label).

B.2   KML annotation example

This is a full KML example created during the OWS10 IE.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gx="http://www.google.com/kml/ext/2.2"
xmlns:kml="http://www.opengis.net/kml/2.2"
xmlns:atom="http://www.w3.org/2005/Atom"
xsi:schemaLocation="http://www.opengis.net/kml/2.2
schemas\2.2.0\ogckml22.xsd">
   <Document>
       <name>Annotation example: Barcelona</name>
       <Style id="anchor">
          <IconStyle>
             <scale>1</scale>
             <heading>0</heading>
              <Icon>
                 <href>http://maps.google.com/mapfiles/kml/shapes/cross-hairs_highlight.png</href>
              </Icon>
             <hotSpot x="20" y="20" xunits="pixels" yunits="pixels"/>
          </IconStyle>
          <LineStyle>
             <color>ff00ff55</color>
             <width>3</width>
          </LineStyle>
          <PolyStyle>
             <color>ffffffff</color>
             <fill>0</fill>
          </PolyStyle>
       </Style>
       <Style id="connector">
          <LineStyle>
             <color>ff0000ff</color>
             <width>5</width>
```

```
                </LineStyle>
                <PolyStyle>
                    <color>ff0000ff</color>
                </PolyStyle>
            </Style>
            <Style id="label">
                <IconStyle>
                    <scale>1</scale>
                    <heading>0</heading>
                     <Icon>
                        <href>http://maps.google.com/mapfiles/kml/pushpin/ylw-
pushpin.png</href>
                     </Icon>
                    <hotSpot x="20" y="2" xunits="pixels" yunits="pixels"/>
                </IconStyle>
                <LabelStyle>
                    <scale>1.6</scale>
                </LabelStyle>
            </Style>
            <Folder id="ID_204">
                <name>Barcelona Annotation</name>
                <open>0</open>
                <atom:link href="http://metadata.usgs.gov/barcelona"
rel="via"/>
                <LookAt>
                    <longitude>2.30</longitude>
                    <latitude>41.35</latitude>
                    <tilt>0</tilt>
                    <range>35000</range>
                </LookAt>
                <Placemark>
                    <name>location</name>
                    <atom:link href="http://features.server.org/gml#id"
rel="related"/>
                    <styleUrl>#anchor</styleUrl>
                    <Polygon>
                        <outerBoundaryIs>
                            <LinearRing>
                                <coordinates>
```

```
                                   2.073639824519578,41.37452244462061,0
2.05804577339133,41.35406278582955,0
2.075388103255338,41.34712555059506,0
2.107622294113374,41.3360311338853,0
2.121911163609469,41.31652845586448,0
2.152920003107866,41.28913819473688,0
2.176382914536645,41.31381322978167,0
2.176950008147636,41.3393838649064,0
2.207216433538022,41.38450586742957,0
2.232587379144657,41.41428095733288,0
2.211479776812355,41.43005352266692,0
2.202149839451644,41.44722711183467,0
2.19158871068049,41.45406371124539,0
2.149643194095574,41.43521126968913,0
2.133102307936627,41.4133862970405,0
2.104176167331617,41.38794227385851,0
2.073639824519578,41.37452244462061,0
                            </coordinates>
                        </LinearRing>
                    </outerBoundaryIs>
                </Polygon>
            </Placemark>
            <Placemark>
                <styleUrl>#anchor</styleUrl>
                <Point>

    <coordinates>2.181361931153667,41.40640566656117,0</coordinates>
                </Point>
            </Placemark>
            <Placemark>
                <name>Connector</name>
                <styleUrl>#connector</styleUrl>
                <LineString>
                    <tessellate>1</tessellate>
                    <coordinates>
                        2.389738560344565,41.44643286255504,0
2.281305678929304,41.44567833933932,0
2.181361931153667,41.40640566656117,0
                    </coordinates>
                </LineString>
            </Placemark>
            <Placemark>
                <name>ConnectorArrowCap</name>
                <styleUrl>#connector</styleUrl>
                <Polygon>
                    <outerBoundaryIs>
                        <LinearRing>
                            <coordinates>
    2.181361931153667,41.40640566656117,0
2.190231576991641,41.4180151568839,0
2.198322244853606,41.40420441241492,0
2.181361931153667,41.40640566656117,0
                            </coordinates>
                        </LinearRing>
                    </outerBoundaryIs>
                </Polygon>
```

```
            </Placemark>
            <Placemark>
                <name>Barcelona</name>
                <styleUrl>#label</styleUrl>
                <Point>

    <coordinates>2.389738560344565,41.44643286255504,0</coordinates>
                </Point>
            </Placemark>
            <GroundOverlay>
                <name>Modernisme</name>
                <Icon>
                    <href>barcelona-spain.jpg</href>
                    <viewBoundScale>0.75</viewBoundScale>
                </Icon>
                <LatLonBox>
                    <north>41.4350345631495</north>
                    <south>41.37804251097081</south>
                    <east>2.516908862505561</east>
                    <west>2.401215711019699</west>
                </LatLonBox>
            </GroundOverlay>
        </Folder>
    </Document>
</kml>
```

Bibliography

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