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CRS and Units Registry

<Document number> – V0.1

April 7 2004

Prepared for
OGC

DRAFT

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1 Overview

This document provides an overview description of the CRS and Units of Measure Registries as defined through the OGC Geography Markup Language and the OGC Catalogue 2.0 (ebRIM profile) or Web Registry Service (WRS).

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Section 3 applies the Dictionary construct to Coordinate Reference Systems (CRS) and provides some brief examples.

Section 4 applies the Dictionary construct to Units of Measure (uom) and provides some brief examples.

Section 5. describes how OGC Web Registry Service (= OGC Catalogue 2.0, ebRIM profile) can be applied to the support of CRS and uom Dictionaries thus creating CRS and uom Registries.

2 Dictionary and Dictionary References in GML

There are two extensibility mechanisms in GML. The most well known one is through XML Schema. Data modellers create new types of GML application objects (GML application vocabulary) by creating XML Schemas (called GML Application Schemas) that import and build on the GML core schemas. This approach is used to create in particular geographic features (e.g. roads, bridges, rivers), metadata packages and even new types of geometries.

A less well know extensibility mechanism in GML is the use of dictionaries. Dictionaries provide a weakly typed mechanism that is particularly attractive when a GML property or attribute (note that XML attributes are NOT used for object properties in GML) takes on a large number of values. The Dictionary mechanism is consistent with broader XML practice and has been applied within the GML world to CRS (Coordinate Reference Systems), location keywords (SRS), and Units of Measure.

The basic idea of a dictionary and dictionary reference is illustrated in the following example.

```
<gml:Point srsName = http://www.myrefsys.xml#p21>
        <gml:pos>100 200</gml:pos>
</gml:Point>
```

How do we interpret the coordinate values in the <gml:pos> element? The answer is by reference to the CRS (Coordinate Reference Systems) that is pointed to by the srsName attribute. The srsName attribute is an anyURI that references a CRS definition in a CRS dictionary. Whether or not the link is dereferenced is up to the data consumer. Data providers are required to see that the reference is valid.

Note that the reference could be local to a definition within the containing XML document or to a file or web service located somewhere on the Internet or private Intranet. To provide greater location transparency it is best practice to use a URN (Uniform Resource Name) rather than a bare URI. The syntax of the URN is up to the authority that hosts the dictionary.

Note that the srsName need not appear on each geometry and typically appears much higher in the hierarchy of objects within the GML document or transaction. It might for example be attached to a <gml:FeatureCollection>, <gml:Envelope> and hence apply by default to all contained features and their associated geometries. This means that in a typical GML document there may be only a small number of such CRS references.

The same dictionary reference idea is used in GML for units of measure. Consider the following example of a Tower with a height property.

```
<abc:Tower gml:id = "s1">
        <gml:description>a very tall tower</gml:description>
        <gml:name>CN Tower</gml:name>
        <abc:height gml:uom = http://www.mysysunits.xml#meters>100.5</height>
        <gml:position> … </gml:position>
</abc:Tower>
```

Note that the height property has an attribute called gml:uom. Its value is also an anyURI and points to a dictionary definition for the units of measure. Note that in this case a non-opaque identifier (meters) has been used. Note carefully that the "meters" is nonetheless is nonetheless simply an identifier and the actual unit of measure is determined by what it references. One should be very careful if one elects to use non-opaque identifiers. In all cases it is the referenced dictionary entry that matters. Note that most users need not look at the referenced dictionary definitions.

GML provides a grammar for the definition of Dictionary objects. A sample dictionary object is as follows:

```
<Dictionary xmlns="http://www.opengis.net/gml"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml ="http://www.opengis.net/gml"
xsi:schemaLocation="http://www.opengis.net/gml
..\Galdos\RandD\GML\GML30~1.1\dictionary.xsd" gml:id="UnitNames">
        <name>Some units</name>
        <dictionaryEntry>
                <Definition gml:id="metre">
                        <name codeSpace="http://www.unitNames.org">metre</name>
                        <name codeSpace="http://www.USunitNames.org">meter</name>
                </Definition>
        </dictionaryEntry>
</Dictionary>
```

Note that the base Dictionary structure contains one or more definition elements (as dictionary entries) and that these provide basic naming functions – allowing a definition to have multiple names in different codeSpaces. A name must be unique within a codeSpace. Note also the gml:id on the Definition. This is what is typically referenced in a uom reference (i.e. gml:uom attribute) as discussed above.

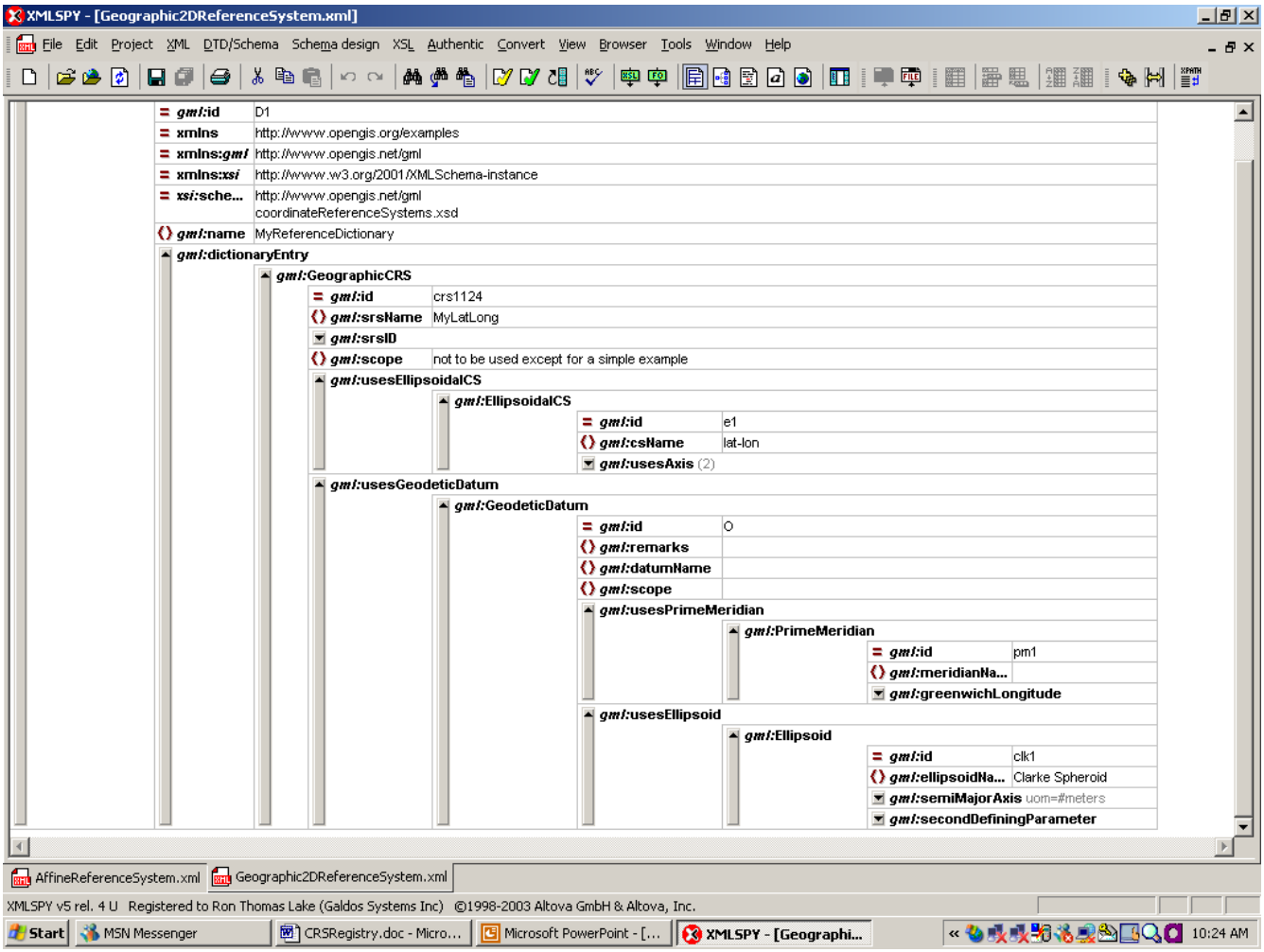
3 Coordinate Reference System Dictionaries

The Dictionary construct is applied within GML to create specific types of dictionaries. One of the most important such dictionaries is the CRS Dictionary. This is illustrated in the following example.

```
<gml:Dictionary gml:id="D1" xmlns="http://www.opengis.org/examples"
xmlns:gml="http://www.opengis.net/gml" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance" xsi:schemaLocation="http://www.opengis.net/gml
coordinateReferenceSystems.xsd">
   <gml:name>...</gml:name>
   <gml:dictionaryEntry>
      <gml:EngineeringCRS gml:id="crs1123">
         <gml:srsName>BodyFixedFrame</gml:srsName>
         <gml:srsID>
            <gml:code>OXYZ</gml:code>
```

```
        </gml:srsID>
        <gml:scope>Assume complete symmetry of the aircraft</gml:scope>
        <gml:usesCS>
          <gml:SphericalCS gml:id="c1">
            <gml:csName/>
            <gml:usesAxis>
              <gml:CoordinateSystemAxis gml:id="x1" gml:uom="#degrees">
                <gml:remarks>X is Astronomical Latitude</gml:remarks>
                <gml:axisName>latitude</gml:axisName>
                <gml:axisAbbrev>lat</gml:axisAbbrev>
                <gml:axisDirection>positive</gml:axisDirection>
              </gml:CoordinateSystemAxis>
            </gml:usesAxis>
            <gml:usesAxis>
              <gml:CoordinateSystemAxis gml:id="x2" gml:uom="#degrees">
                <gml:remarks>Y is Astronomical Longitude</gml:remarks>
                <gml:axisName>longitude</gml:axisName>
                <gml:axisAbbrev>long</gml:axisAbbrev>
                <gml:axisDirection>positive</gml:axisDirection>
              </gml:CoordinateSystemAxis>
            </gml:usesAxis>
            <gml:usesAxis>
              <gml:CoordinateSystemAxis gml:id="x3" gml:uom="#meters">
                <gml:remarks>Z is orthogonal to X and Y, pointing downward. A positive
rotation about the Z-axis corresponds to a positive counter-clockwise rotation in
yaw.</gml:remarks>
                <gml:axisName>Z-axis</gml:axisName>
                <gml:axisAbbrev>OZ</gml:axisAbbrev>
                <gml:axisDirection>defined by cross product of X and
Y</gml:axisDirection>
              </gml:CoordinateSystemAxis>
            </gml:usesAxis>
          </gml:SphericalCS>
        </gml:usesCS>
        <gml:usesEngineeringDatum>
          <gml:EngineeringDatum gml:id="O">
            <gml:remarks>Origin of the CRS is the vehicle center of mass
O</gml:remarks>
            <gml:datumName>CenterOfMass</gml:datumName>
            <gml:anchorPoint>O</gml:anchorPoint>
            <gml:scope>Used to define points relative to the aircraft.</gml:scope>
          </gml:EngineeringDatum>
        </gml:usesEngineeringDatum>
      </gml:EngineeringCRS>
    </gml:dictionaryEntry>
</gml:Dictionary>
```

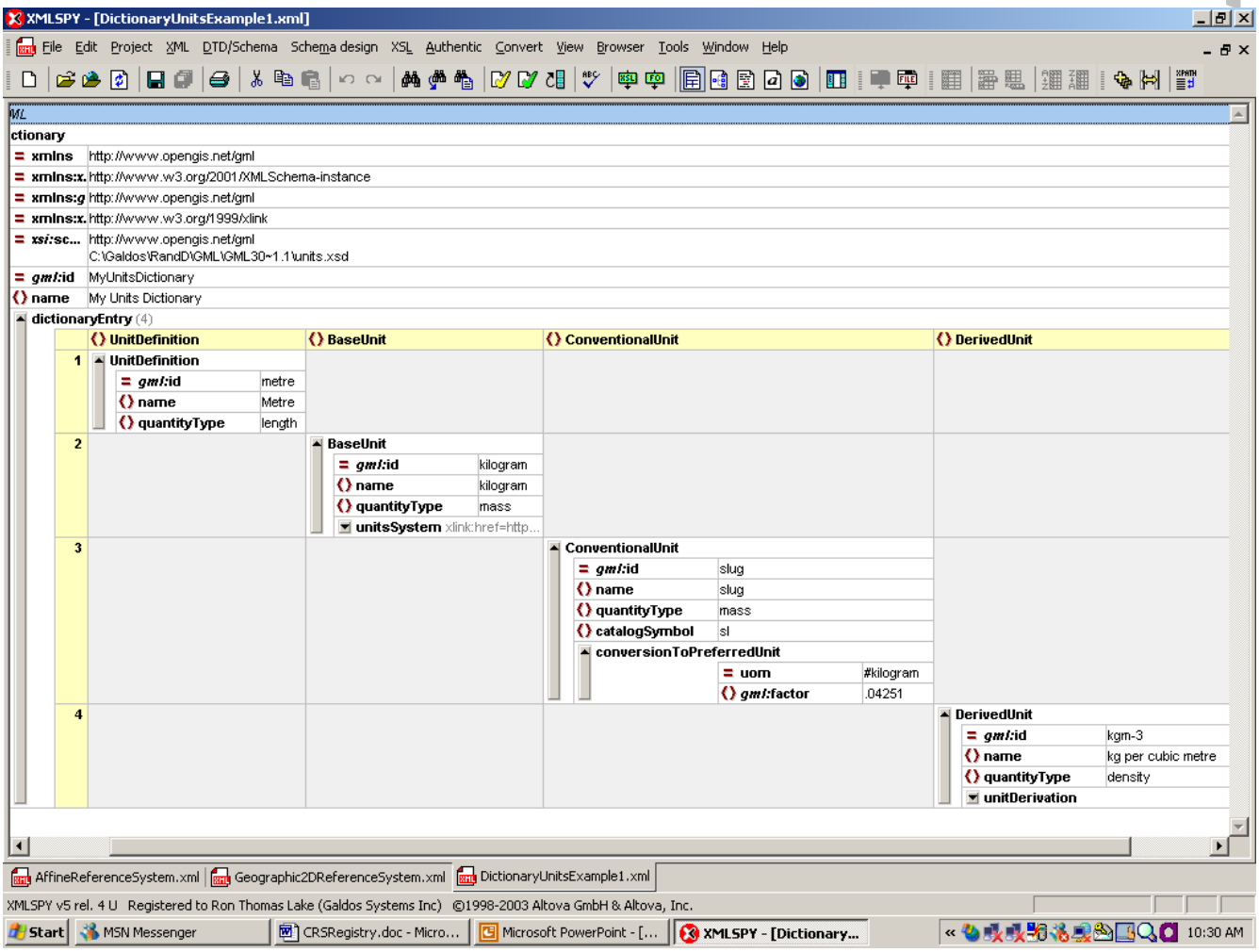
The GML grammar allows the user to create a wide variety of CRS dictionary entries. The above example contains a dictionary with only a single entry, namely a simple Affine CRS that might be used in CAD or surveying. The next example shows the same dictionary with an earth-based coordinate reference system using the XMLSpy grid presentation:



Note that the CRS definition is built out of components that describe the Ellipsoid, Prime Meridian, Geodetic Datum etc. GML can describe more or less any CRS whether referenced to the earth or not. A CRS dictionary could thus contains thousands of dictionary entries.

4 Units of Measure Dictionaries

GML also applies the dictionary construct to Units of Measure as discussed in Section 2. This is illustrated in the following simple example.



Note that the Units of Measure dictionary can support various kinds of units consistent with ISO practice including Base units, Conventional and Derived Units. The XML version of the above is as follows:

```
<Dictionary xmlns="http://www.opengis.net/gml"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://www.opengis.net/gml
C:\Galdos\RandD\GML\GML30~1.1\units.xsd" gml:id="MyUnitsDictionary">
    <name>My Units Dictionary</name>
    <dictionaryEntry>
        <UnitDefinition gml:id="metre">
            <name>Metre</name>
            <quantityType>length</quantityType>
        </UnitDefinition>
    </dictionaryEntry>
    <dictionaryEntry>
        <BaseUnit gml:id="kilogram">
```

```
            <name>kilogram</name>
            <quantityType>mass</quantityType>
            <unitsSystem xlink:href="http://www.refsystems.org/ISO"/>
        </BaseUnit>
    </dictionaryEntry>
    <dictionaryEntry>
        <ConventionalUnit gml:id="slug">
            <name>slug</name>
            <quantityType>mass</quantityType>
            <catalogSymbol>sl</catalogSymbol>
            <conversionToPreferredUnit uom="#kilogram">
                <gml:factor>.04251</gml:factor>
            </conversionToPreferredUnit>
        </ConventionalUnit>
    </dictionaryEntry>
    <dictionaryEntry>
        <DerivedUnit gml:id="kgm-3">
            <name>kg per cubic metre</name>
            <quantityType>density</quantityType>
            <unitDerivation>
                <unitTerm uom="#kilogram" exponent="1"/>
                <unitTerm uom="#metre" exponent="-3"/>
            </unitDerivation>
        </DerivedUnit>
    </dictionaryEntry>
</Dictionary>
```

Essentially any kind of unit can be defined. GML unit dictionaries may contain hundreds or thousands of entries.

5 Registries and GML Dictionaries

OGC has closely tracked the activities of OASIS over the past several years. In particular, the OGC has developed a profile of its Catalogue 2.0 Specification base on OASIS ebRIM, called the Web Registry Service (WRS). The WRS is currently based on the ebRIM information model (ebRIM v2.5). WRS uses OGC defined interfaces, and filter grammar, however, all of the features of ebRIM (e.g. life cycle management, classification schemes, associations, and audit trail are available. The OGC Catalogue interfaces provide a search and update grammar based on XML so that the WRS is a web service that can be supported over HTTP, SOAP etc.

OGC Web Registry Services can be used to host GML Dictionaries including CRS Dictionaries and Units of Measure Dictionaries in which case we speak of CRS Registries or Units of Measure Registries. The intent is that the content of such registries be controlled by specific authorities and that they represent a second level of normalization relative to written specification documents.

To date there have been few hosted CRS or Units of Measure Registries. An early version of a CRS Registry can be found at http://crs.opengis.org/crsportal. This is a prototype registry based on a pre-release version of the GML 3. schemas for CRS, an early version of the WRS, and the content from the European Petroleum Survey Group (EPSG) v6.1 CRS database. This is a web service and can be accessed as such over the Internet. It does not support the current OGC WRS interfaces at present but should be updated to this status in the near future.

Since this is a WRS (hence a web service) there is a need for authentication and access control. This can be provided using OASIS SAML and XACML (for policies). The address shown is the address of the human interface (DHTML). The web service address can be provided on request.