Open Geospatial Consortium Inc.

Date: 2007-06-18

Reference number of this OGC® document: OGC 06-080r2

Version: 0.9.0

Category: OpenGIS® Best Practices

Editor: Jerome Gasperi

GML 3.1.1 Application schema for Earth Observation products

Warning

This is an OGC Best Practices document. It is not an OGC Standard and may not be referred to as an OGC Standard. It is subject to change without notice. However, this document is an official position of the OGC membership on this particular technology topic.

Document type :	OGC Best Practices
Document subtype :	GML Application Schema
Document stage:	Proposed
Document language:	English

Contents

Page

Figures

Page

Tables

Page

i. Preface

This document defines an application schema of the Geography Markup Language (GML) version 3.1.1 for describing Earth Observation products (EO products) within the HMA (Heterogeneous EO Missions Accessibility) Application Profile for the OGC® Catalogue Services Specification v2.0.0 (with Corrigendum) [OGC 04-021r3]

Suggested additions, changes, and comments on this draft report are welcome and encouraged. Such suggestions may be submitted by email message or by making suggested changes in an edited copy of this document.

ii. Document terms and definitions

This document uses the specification terms defined in Subclause 5.3 of [OGC 05-008]. In particular, the word "shall" (not "must") is the verb form used to indicate a requirement to be strictly followed to conform to this specification.

iii. Submitting organizations

This application schema is being submitted to the OGC by the following organizations:

- **ESA – European Space Agency**
- **CNES – French Space Agency**
- **EUSC**
- **Spacebel s.a.**
- **Spot Image**

The editors would like to acknowledge that this work is the result of collaboration and review of many organizations and would like to thank for the comments and contributions from :

- **ASI**
- **Conterra**
- **DLR**

- **Eumetsat**
- **MDA**

Note : this does not imply a complete endorsement from these organizations).

iv. Document contributor contact points

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

Jerome Gasperi (Editor)
CNES
jerome.gasperi@cnes.fr

Contributors:

Name	Organization
Christophe Dabin	CNES
Patrick Floissac	MAGELLIUM (CNES Sub contractor)
Jolyon Martin	ESA

v. Revision history

Date	Release	Editor	Primary clauses modified	Description
11 May 2006	0.1.0	Jerome Gasperi	N/A	Initial document
29 May 2006	0.1.1	Jerome Gasperi	N/A	Updated after telecom meeting
21 August 2006	0.1.2	Jerome Gasperi	N/A	Update document after Ron Lake comments. Update document regarding version 0.91 of the XML schemas
19 September 2006	0.1.3	Jerome Gasperi	N/A	Update document regarding version 0.92 of the XML schema
24 November 2006	0.1.4	Jerome Gasperi	N/A	Use of gml:Observation for schema description. Update document regarding version 0.94 of the XML schema
8 December 2006	0.1.4 06-080r1	Jolyon Martin	N/A	Updated draft re-numbered as 06-080r1 Minor update of introduction
7 February 2007	0.1.4 06-	Jerome Gasperi	N/A	Updated draft re-numbered as 06-080r2

	080r2			Conformance with hma RIDS (CDR#34, CDR#35, CDR#49, CDR#58, CDR#71). Update document regarding version 0.95 of the XML schema Schemas import a gml subset (gmlSubset.xsd given in annex)
21 May 2007	0.1.5 06-080r2	Jerome Gasperi	N/A	Updated draft re-numbered as 06-080r3 Change pointingAngles to incidenceAngles. Add hma:composedOf, hma:subsetOf and hma:linkedWith within EarthObservationMetadata Update document regarding version 1.0beta of the XML schema
18 june 2007	1.0 06-080r2	Jerome Gasperi	N/A	Updated draft re-numbered as 06-080r4 Change gml:extentOf to gml:multiExtentOf to allow multi-polygons in footprint Update document regarding version 1.0 of the XML schema

vi. Changes to OGC Specifications

The previously approved OGC® Specifications do not need changes to accommodate the technical contents of this document.

vii. Future work

At this stage, this document is a working document that will be filled with the ongoing work on schemas definition.

Foreword

This document specifies an application schema of the existing OGC Implementation Specification for the Geographic Markup Language (GML) version 3.1.1 [OGC 03-105r1 and 04-092r4]. It is a GML application schema as specified in Subclause 23 of [OGC 03-105r1].

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 Inc. 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 specification set forth in this document, and to provide supporting documentation.

Introduction

The Geography Markup Language is an XML grammar written in XML Schema for the modelling, transport, and storage of geographic information.
From the GML specification, "GML provides a variety of kinds of objects for describing geography including features, coordinate reference systems, geometry, topology, time, units of measure and generalized values. A geographic feature is an abstraction of a real world phenomenon; it is a geographic feature if it is associated with a location relative to the Earth".

EO data product collections are usually structured to contain data items derived from a sensor onboard a satellite or series of sensors. The key characteristics differentiating these products are date of acquisition, location and in some cases, such as the optical imagery, the possible presence of cloud, haze, smokes or other atmospheric or on ground phenomena obscuring the image. These are the key characteristics; there are however other metadata that are required to identify products of interest.

From a user point of view, an EO data product can be naturally described with a spatial extension (e.g. the geographic footprint of a satellite acquisition) and several attributes describing the metadata (e.g. date of acquisition, etc.). Indeed this point of view is consistent with a GML representation of the data.

The intent of this document is to describe a core interface for EO data product described as a GML version 3.1.1 application schema that can be supported by many data providers (satellite operators, data distributors …). The metadata described is that which is commonly provided through catalogue interfaces, it does not necessarily include all of the metadata that is present in the actual EO data product (e.g. calibration coefficients etc.).

In addition, this document describes the mechanism used to extend the general core interface to thematic EO product such as optical, radar and atmospheric missions and to very specific mission such as the French Pleiades mission.

GML 3.1.1 application schema for EO Products

1 Scope

This application schema document describes the encodings required to describe Earth Observation (EO) products from general to mission specific characteristics.

This document specifies three compliance levels :

- The general level, or “hma” level, describes the general EO Products schema;
- The thematic level extends the “hma” level to describes thematic EO Products such as optical, radar or atmospheric products (respectively “ohr”, “sar”, “atm” levels);
- The mission specific level extends one of the “thematic” level to describes mission specific EO Products. For instance the French Pleiades mission uses the “phr” level which extends the “ohr” thematic level.

2 Compliance

EO Products data encoded using this application schema shall produce XML documents that are fully compliant with normative XML Schema Documents associated with this specification (i.e. *hma.xsd* for general EO Products, *ohr.xsd*, *sar.xsd* and *atm.xsd* for optical, radar and atmospheric products respectively).

More specifically, compliance with this specification shall be checked using all the relevant tests specified in Annex A (normative).

3 Normative references

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

OGC 03-105r1, *OpenGIS Geography Markup Language (GML) Implementation Specification*, Version 3.1.0,

OGC 04-092r4, *GML 3.1.1 schemas*

OGC 05-008, *OGC Web Services Common Specification*, Version 1.0.0

OGC 05-010, *URNs of definitions in ogc namespace* (Recommendation Paper), Version 1.0.0

W3C, *Extensible Markup Language (XML) 1.0* (Second Edition), W3C Recommendation, 6 October 2000, http://www.w3.org/TR/REC-xml

W3C, *XML Schema Part 1: Structures*, http://www.w3.org/TR/xmlschema-1

W3C, *XML Schema Part 2: Datatypes*, http://www.w3.org/TR/xmlschema-2

W3C, *Namespaces in XML*, http://www.w3.org/TR/1999/REC-xml-names-19990114

In addition to this document, this specification includes several normative XML Schema files. Following approval of this document, these schemas will be posted online at the URL: http://bp.schemas.opengis.net/06-080r2/. These XML Schema files are also bundled with the present document. In the event of a discrepancy between the bundled and online versions of the XML Schema files, the online files shall be considered authoritative.

4 Terms and definitions

For the purposes of this specification, the definitions specified in Clause 4 of the OWS Common Implementation Specification [OGC 05-008] shall apply. In addition, the following terms and definitions apply.

4.1
client
software component that can invoke an **operation** from a **server**

4.2
datastrip
A satellite acquisition

4.3
geographic information
information concerning phenomena implicitly or explicitly associated with a location relative to the Earth [ISO 19128 draft]

4.4
identifier
a character string that may be composed of numbers and characters that is exchanged between the client and the server with respect to a specific identity of a resource

4.5
qualified name
name that is prefixed with its naming context

EXAMPLE The qualified name for the road no attribute in class Road defined in the Roadmap schema is RoadMap.Road.road_no. [ISO 19118].

4.6
request
invocation of an **operation** by a **client**

4.7
response
result of an **operation,** returned from a **server** to a **client**

4.8
scene
The cutting of a datastrip into part. For PHR mission, a scene is a 20x20 km^2 square part.

4.9
schema
formal description of a model [ISO 19101, ISO 19103, ISO 19109, ISO 19118]

5 Conventions

5.1 Abbreviated terms

The abbreviated terms used in this document include:

ATM Atmospheric

EO Earth Observation

GML Geography Markup Language

HMA Heterogeneous Mission Accessibility

OGC Open Geospatial Consortium

PHR Pleiades High Resolution

OHR Optical High Resolution

SAR Synthetic Aperture Radar

XML eXtensible Markup Language

5.2 Namespace prefix conventions

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

Prefix	Namespace URI	Description
hma	http://earth.esa.int/hma	General EO product schema namespace
ohr	http://earth.esa.int/ohr	Optical High Resolution EO product schema namespace
sar	http://earth.esa.int/sar	Radar EO product schema namespace
atm	http://earth.esa.int/atm	Atmospheric EO product schema namespace
phr	http://hma.cnes.fr/phr	Pleiades High Resolution product schema namespace

Table 1 : namespace mappings

6 Overview

This section focuses on the purpose of the document. In particular, it describes the context of use of the EO Product application schema.

6.1 General concepts

Our approach consists in modelling EO data product through a GML application schema, using ISO definitions for attributes where available, although not using the full ISO schema for the structural definitions, which would lead to a less efficient overall structure.

The general mechanism is to create a schema with a dedicated namespace for each level of specificity from a general description which is common to each EO Product to a restricted description for specific mission EO Product. Each level of specificity is an extension of the previous one.

The General EO product schema is the main application schema for EO Product data. It is associated with the “hma” namespace.

Each Thematic EO product schemas extends the “hma” schema :

- The Optical EO Product schema is used to describe optical products. It is associated with the “ohr” namespace;

- The SAR EO Product schema is used to describe radar products. It is associated with the “sar” namespace;

- The Atmospheric EO Product schema is used to describe atmospheric products. It is associated with the “atm” namespace;

The idea behind this set of layered levels approach, is

1) to create an efficient schema set that describes EO Product metadata concentrating on the core metadata that key characteristics differentiate a products within a collection.

2) to profit by the widespread use of GML so that our products can be displayed by a large variety of GML viewer from generic one, which will see EO Products as features with footprint and “unknown” metadata, to EO Product specific one, which will understand the semantic of these metadata (cf. Figure 1)

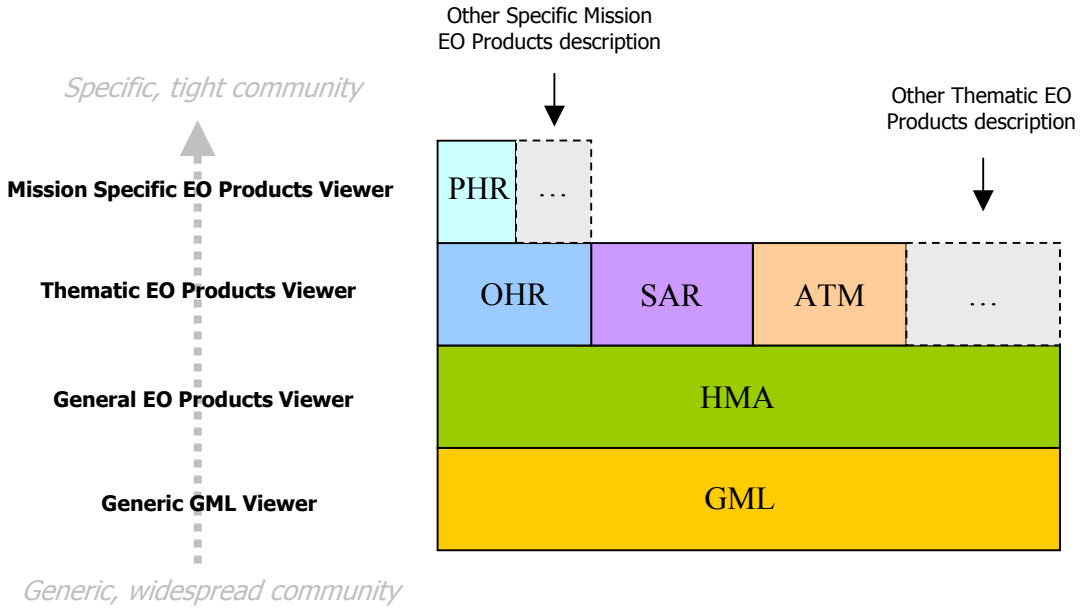

Figure 1 : A layered view of GML EO Products data..

More precisely, a generic GML viewer will only understand the “gml” vocabulary of the GML document; a “Generic EO Products viewer” will understand the “gml” and “hma” vocabulary of the GML document; an “Optical EO Products viewer” will understand the “gml”, “hma” and “ohr” vocabulary of the GML document. The “phr” vocabulary will

only be understood by a “Specific PHR Viewer” that extends the “Optical EO Products Viewer”.

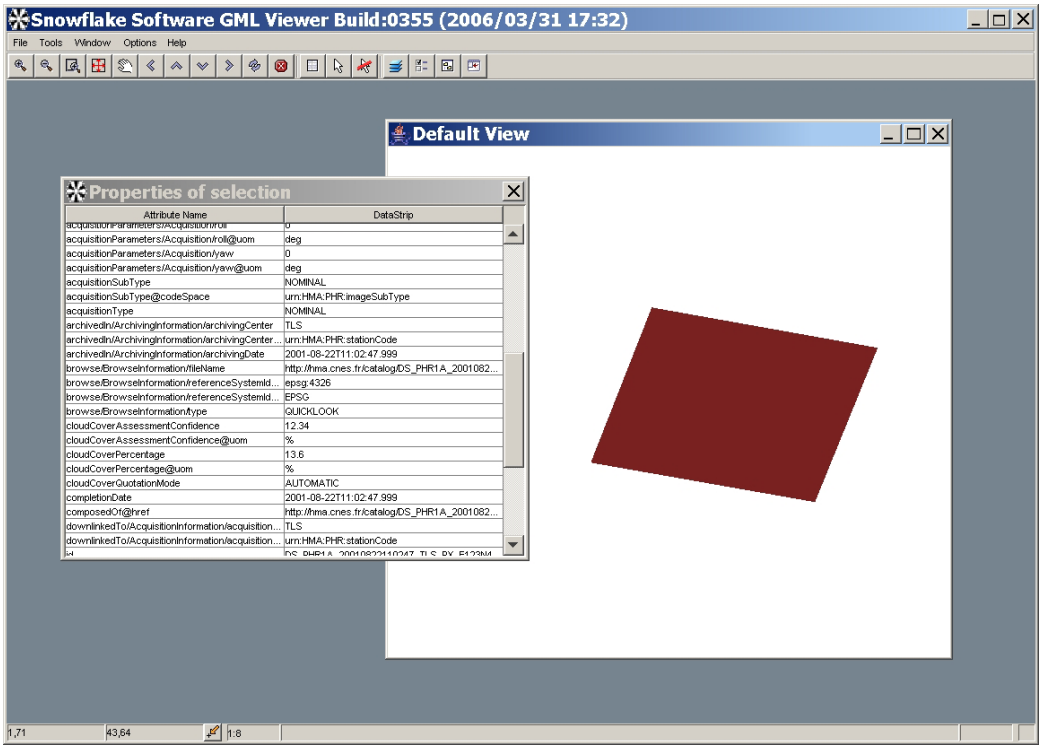

Figure 2 : A generic GML viewer understand the “gml” vocabulary and thus displays the product footprint (gml:multiExtentOf property). With no semantic knowledge on the EO product schema, the reader is able to displays the related attributes in an xpath/value fashion

6.2 GML Observation

An Observation in GML models the act of observing or measuring some quantity. The quantity to be measured can be simple (a single temperature), or it may be a complex quantity like a Coverage. Remotely sensed images in the sense of their acquisition can be viewed as observations in which the result of the observation (value of the resultOf property) is a remotely-sensed image product.

The structure of a GML observation is as follows :

- metadataProperty – general metadata describing the observation ;
- validTime - when the observing took place ;
- using - the mechanism (procedure, instrument etc.) used in the observing ;
- target - the entity that is the subject or target of the observation ;
- resultOf - what resulted from the observing.

6.2.1 Earth Observation mapping on gml:Observation

We modelled the Earth Observation to fit exactly the *gml:Observation* structure and always have the same first level structure (i.e. *gml:using*, *gml:target*, etc.).

Thus, the hma namespace contains :

- hma "words" (i.e. technically speaking global element declaration) : *identifier*, *status*, *dowlinkedTo*, etc. This words are referenced inside higher level structure (or "blocks", see Table 2)

- an *hma:EarthObservation* element that inherits from *gml:Observation.* This inheritance is an XML schema extension (to avoid restriction problems) with no element added (because all elements fit inside one of the *gml:Observation* property *metadaProperty*, *validTime*, *using*, *target* or *resultOf*)

The content of *gml:Observation* properties is as follows :

Property	Description within Earth Observation context	Awaited Content
metadaProperty	Describe general properties such as the data identifier, the downlink and archiving information	*hma:EarthObservationMetadata*
validTime	Describe the acquisition duration, i.e. the start and end date of acquisition	*gml:TimePeriod/gml:beginPosition* *gml:TimePeriod/gml:endPosition*
using	Describe the Platform/Instrument/Sensor used for the acquisition and the acquisition parameters (i.e. pointing angles, etc.)	*hma:EarthObservationEquipment*
target	Describe the observed area on ground i.e. the footprint of acquisition	*hma:Footprint*
resultOf	Describe the Earth Observation result composed of the browse, mask and product description	*hma:EarthObservationResult*

Table 2: *gml:Observation* properties mapping within Eart Observation context

The elements *hma:EarthObservationMetadata*, *hma:EarthObservationInstrument*, *hma:Footprint* and *hma:EarthObservationResult* are described in §7.

6.3 General rules

We defined the following rules for creating the application schemas.

6.3.1 Language rules

Natural language used as far as possible for property names. For instance, complete names for properties are preferred to abreviations.

Property name “composedOf” is used to define structural links to extended metadata. For instance a “phr:Datastrip” is logically splitted into one or more ”phr:Scene”. Thus, each Scene in the “phr:Datastrip” schema is referenced with the “hma:composedOf” property.

Property name “subsetOf” is used to define structural links to “father” metadata. For instance in the previous example, the “phr:Datastrip” is referenced within the “phr:Scene” by the “hma:subsetOf” property name.

6.3.2 Extensions rules

As see in §6.2.1, we want each Earth Observation product to fit exactly the structure of a *gml:Observation* element.

Thus, in the inheritance mechanism for thematic or mission specific namespaces, we need to extends existing properties defined in hma or create new property that fit inside the model.

6.3.2.1 Thematic extended namespace

Thematic extended namespace (ohr for example) contains :

- ohr "words";
- an *ohr:EarthObservation* element that inherits from *hma:EarthObservation.* This inheritance is an XML schema extension (to avoid restriction problems) with no element added (because all elements fit inside one of the Observation property *metadaProperty*, *validTime*, *using*, *target* or *resultOf*);
- one or more extension of existing hma properties (see example below).

For example, “ohr” thematic EO Products metadata include the solar azimuth angle, named “illuminationAzimuthAngle”. This property is described within *ohr:Acquisition* element which extends and acts as a substitution for *hma:Acquisition* :

```
<ohr:EarthObservation>
    […]
    <gml:using>
        <hma:EarthObservationEquipment>
            […]
            <hma:acquisitionParameters>
                <ohr:Acquisition>
                    […]
                    <hma:orbitDirection>ASCENDING</hma:orbitDirection>
                    […]
                    <ohr:illumationAzimuthAngle>56,67</ohr:illumationAzimuthAngle>
                </ohr:Acquisition>
            </hma:acquisitionParameters>
```



```
            […]
        </hma:EarthObservationEquipment>
    </gml:using>
    […]
</ohr: EarthObservation>
```

6.3.2.2 Mission specific extended namespace

Mission specific extended namespace (phr for example) contains :

- phr "words";
- a *phr:EarthObservation* element that inherits from *ohr:EarthObservation*. This inheritance is an XML schema extension (to avoid restriction problems) with no element added (because all elements fit inside one of the Observation property *metadaProperty*, *validTime*, *using*, *target* or *resultOf*);
- one or more extension of existing ohr properties (e.g. in phr, an extension of *ohr:EarthObservationResult* to add cloudCoverPercentageConfidenceIndex).

These rules are closed to those described in the thematic extended namespace. However, the property extension approach leads to a drawback in the mission specific case.

Indeed, from a client point of view, an “hma” enabled reader must encounter well-known structures under a “hma” properties. This may not be a problem for “hma” and thematics schemas since they are completely described in this document (i.e. structure can be “hard coded”).

However, a mission specific schema shall follow the rules described in this document but the content of this schema is not in the scope of this document. Thus a generic “hma” enabled reader shall be able to process complex schema inheritance mechanisms to “understand” mission specific data.

To avoid this drawback, we introduce an attribute "*hma:type*" at the hma level. This attribute is required for properties that extends one of hma or thematic property. This attribute is expected to contain the name of the property it extends directly. This mechanism is comparable to the ISO19139 *gco:isoType*.

For example for a *phr:DataStrip* that extends *ohr:EarthObservation* :

```
<phr:DataStrip hma:type="ohr:EarthObservation">
    [...]
    <gml:resultOf>
        <phr:EarthObservationResult hma:type="ohr:EarthObservationResult">
            <hma:browse>
            <hma:product>
            <hma:mask>
            <ohr:cloudCoverPercentage uom='%'>30</ohr:cloudCoverPercentage>
            <phr:cloudCoverAssessmentConfidence uom='%'>10</phr:cloudCoverAssessmentConfidence>
        </phr:EarthObservationResult>
    </gml:resultOf>
    [...]
```

```
</phr:DataStrip>
```

6.3.3 Use of Schematron

The *gml:Observation* properties have a very generic defintion that do not offer sufficient content constraints within XML Schema, e.g. :

- *using* : any gml Feature;
- *target* : any gml Feature or Geometry;
- *resultOf* : any gml Object.

This leads to an Earth Observation model with properties that cannot be tightly validated with the XML schema mechanism.

To clarify, let's take an example. The *hma:EarthObservationEquipement* feature shall be used under the "*gml:using*" property. Nevertheless, the following documents would perfectly validate:

- a *gml:Observation* with any other feature that a *EarthObservationEquipement* under the "*using*" property;
- a *gml:Observation* with a "*EarthObservationEquipement*" under the "*resultOf*" property (since a gml feature inherits from gml object).

A proposed solution to have tightly validated Earth Observation products is to complement XML schema with the use of Schematron.

6.3.3.1 Schematron basics

Schematron is a rule-based language that uses XPath to express assertions about the content in an XML instance document. This can be done by transforming the Schematron schema with a base stylesheet, which turns the schema into an XSLT stylesheet. The stylesheet checks the assertions defined by running the XML instance document through an XSLT processor. The result of the transformation is a report, in XML format, that contains details on which assertions failed along with the comments provided with that particular rule in the schema.

Applied to the Earth Observation products case, this can be summarized in Figure 3.

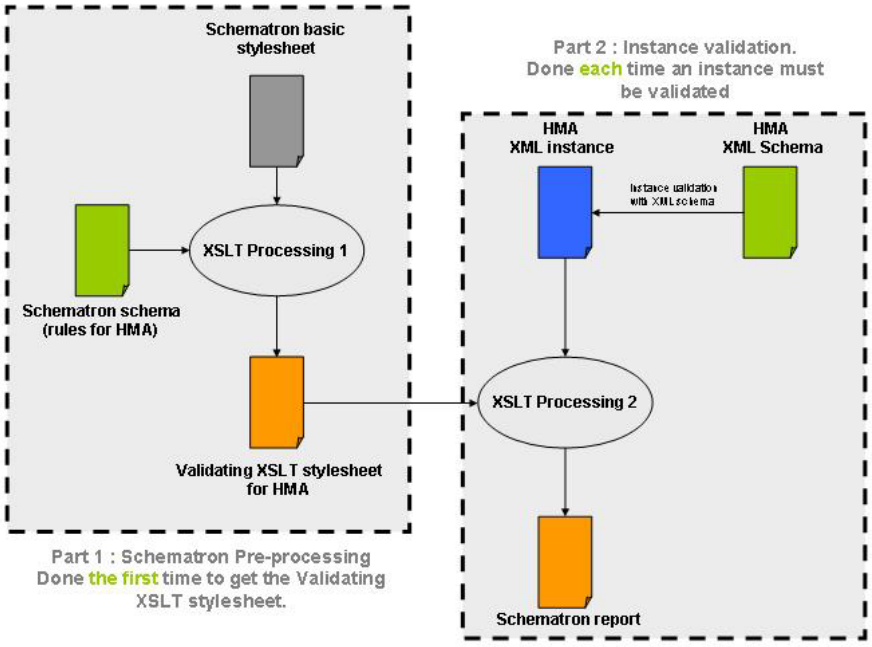

Figure 3 : schematron processing for Earth Observation products

The "Part 1 : pre-processing" step is needed to get the validating stylesheet for HMA. It is processed from :

- the schematron basic stylesheet (aka "skeleton stylesheet") from http://www.schematron.com slightly modified for hma (i.e. add hma namespaces into the skeleton : *schematron_skeleton_for_hma.xsl;*
- the schematron schema rules for hma : *schematron_rules_for_hma.sch*;
- an XSLT processor.

We used XMLSpy 2004 as the XSLT processor to generate the validating stylesheet *schematron_result_for_hma.xsl*

This processing is done only one time. This stylesheet will then be used each time we need to validate an HMA XML instance : first an HMA XML instance is validated syntaxically and semantically by the HMA XML schema; second it is validated against the validating sylesheet. The schematron report indicates if error where found.

6.3.3.2 Schematron rules for hma

The following rules were defined at the hma level :

- *gml:metadataProperty* must contains an *hma:EarthObservationMetadata*;
- *gml:validTime* must contains a *gml:TimePeriod/gml:beginPosition* and *gml:TimePeriod/gml:endPosition* ;
- *gml:using* must contains an *hma:EarthObservationEquipement* ;
- *gml:target* must contains an *hma:Footprint* ;
- *gml:multiExtentOf* must contains a *gml:MultiSurface/gml:surfaceMembers/gml:Polygon/gml:exterior/gml:LinearRing/gml:posList* ;
- *gml:resultOf* must contains an *hma:EarthObservationResult*.

More generally, the schematron rules for extension in the general case can be summarized as follow:

- if root element is *hma:EarthObservation* then the whole property are in the *hma* namespace ;
- if root element is *ohr:EarthObservation* then the whole property are in the *hma* namespace or in the *ohr* namespace ;
- if root element is *sar:EarthObservation* then the whole property are in the *hma* namespace or in the *sar* namespace ;
- if root element is *atm:EarthObservation* then the whole property are in the *hma* namespace or in the *atm* namespace ;
- if root element is *xxx:EarthObservation*, where *xxx* is a specific mission namespace, then the whole property are in the *hma* namespace or in the thematic namespace extended by *xxx* (i.e. *ohr*, *sar* or *atm*) or must be defined with a *hma:type* attribute containing explicitely the property it extends directly

6.3.4 CodeList

Property that shall be described within a given codeSpace shall use the <hma:CodeWithAuthorityType>. Note that this type will be replaced by the incoming <gml:CodeWithAuthorityType> (shall be available in GML 3.2).

```
<xs:complexType name="CodeWithAuthorityType">
    <xs:annotation>
        <xs:documentation>From GML 3.2 draft</xs:documentation>
    </xs:annotation>
    <xs:simpleContent>
        <xs:extension base="xs:string">
```



```
            <xs:attribute name="codeSpace" type="xs:anyURI" use="required"/>
        </xs:extension>
    </xs:simpleContent>
</xs:complexType>
```

Example : to guarantee the uniqueness of the EarthObservationProduct identifier within HMA, the <hma:identifier> includes the ground segment namespace through the codeSpace attribute.

```
<hma:identifier
codeSpace="urn:HMA:PHR:catalog:TLS:id">DS_PHR1A_20010822110247_TLS_PX_E123N45_0101_012
34</hma:identifier>
```

6.3.5 Units of measure

Each non-angle property concerned by a unit of measure shall use the existing GML type <gml:MeasureType>.

Example : image resolution

```
<xs:element name="resolution" type="gml:MeasureType">
    <xs:annotation>
        <xs:documentation>Image resolution</xs:documentation>
    </xs:annotation>
</xs:element>
```

Each angle property shall use the existing GML type <gml:AngleType>.

Example : Across Track incidence angle

```
<xs:element name="acrossTrackIncidenceAngle" type="gml:AngleType" minOccurs="0">
        <xs:annotation>
            <xs:documentation>Across Track Incidence angle given in degrees.</xs:documentation>
        </xs:annotation>
</xs:element>
```

6.3.6 Use of xlink

Properties that shall only describe an urn shall use the <hma :HrefPropertyType>. This complex type is a restriction of <gml:FeaturePropertyType> that only includes the “xlink” attribute.

```
<xs:complexType name="HrefPropertyType">
    <xs:complexContent>
        <xs:restriction base="gml:FeaturePropertyType">
            <xs:sequence/>
            <xs:attribute ref="xlink:href" use="required"/>
        </xs:restriction>
    </xs:complexContent>
</xs:complexType>
```

Properties that shall describe either an urn or the content of that urn shall use an extension of <gml:AbstractFeatureType>.

Example : “composedOf” property reference either the urn (xlink attribute) or the GML content of an EarthObservationProduct.
Thus in <hma:EarthObservation> the element “composedOf” is defined as an <hma:EarthObservation> which extend <gml:AbstractFeatureType>.

```
<xs:element name="composedOf" type="hma:EarthObservationPropertyType"/>
<xs:complexType name="EarthObservationPropertyType">
    <xs:sequence>
        <xs:element ref="hma:EarthObservation" minOccurs="0"/>
    </xs:sequence>
    <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
```

6.3.7 GML restrictive use

We restricted the use of GML types to those relevant to the EO Products metadata description, i.e. :

- gml:Observation ;
- gml:Feature ;
- gml:AngleType ;
- gml:CodeListType ;
- gml:MeasureType ;
- gml:centerOf (expected structure : gml:Point/gml:pos) ;
- gml:multiExtentOf (expected structure : gml:MultiSurface/gml:surfaceMembers/gml:Polygon/gml:exterior/gml:LinearRing/gml:posList)

See chapter 7.3 for discussion about this restrictive use of GML.

7 EO Products application schemas

7.1 General EO product data schema

The “hma” schema provides the description of metadata common to all EO Products derived from satellite based remote sensing.

The root element of the “hma” schema, named <hma:EarthObservation> extends the <gml:ObservationType> type as follows :

```
<xs:element name="EarthObservation" type="hma:EarthObservationType"
```



```
                substitutionGroup="gml:Observation"/>

<xs:complexType name="EarthObservationType">
    <xs:complexContent>
        <xs:extension base="gml:ObservationType"/>
    </xs:complexContent>
</xs:complexType>
```

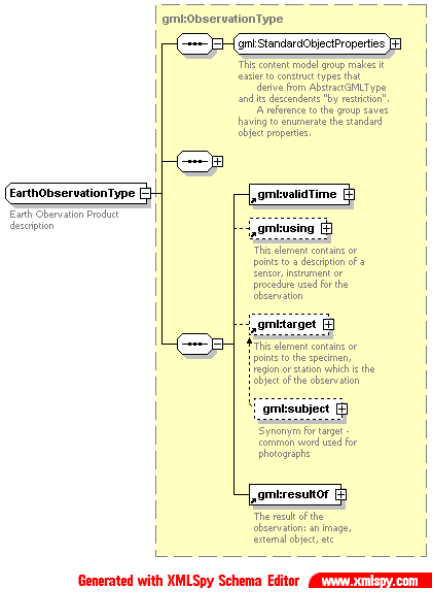

Figure 4: <hma:EarthObservationType> **diagram**

The "hma" metadata are referenced inside higher level structure (see Table 2) :

- *hma:EarthObservationMetadata*;
- *hma:EarthObservationEquipment*;
- *hma:Footprint*;
- *hma:EarthObservationResult*;

Complete description of an *EarthObservation* element is given in Table 3.

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
gml:validTime/ gml:TimePeriod/ gml:beginPosition	Acquisition start date time dateTime in ISO 8601 format (CCYY-MM-DDThh:mm[:ss[.cc]]Z)	MI_AcquisitionInformation/ MI_MissionIdentification/ startDate	no	1

gml:validTime/ gml:TimePeriod/ gml:endPosition	Acquisition end date time dateTime in ISO 8601 format (CCYY-MM-DDThh:mm[:ss[.cc]]Z)	MI_AcquisitionInformation/ MI_MissionIdentification/ completionDate	no	1
gml:using/ hma:EarthObservationEquipment	Platform/Instrument/Sensor used for the acquisition and the acquisition parameters (i.e. pointing angles, etc.)		no	0..1
gml:target/ hma:Footprint	Observed area on ground i.e. the footprint of acquisition		no	0..1
gml:resultOf/ hma:EarthObservationResult	Earth Observation result composed of the browse, mask and product description		no	0..1

Table 3 : <hma:EarthObservation> **fields description**

7.1.1 EarthObservationMetadata

The *hma:EarthObservationMetadata* block contains all the metadata relative to an *hma:EarthObservation* that do not fit inside one of the other blocks, i.e. metadata that don't describe the time, the mechanism, the location or the result of the observation (Figure 5).

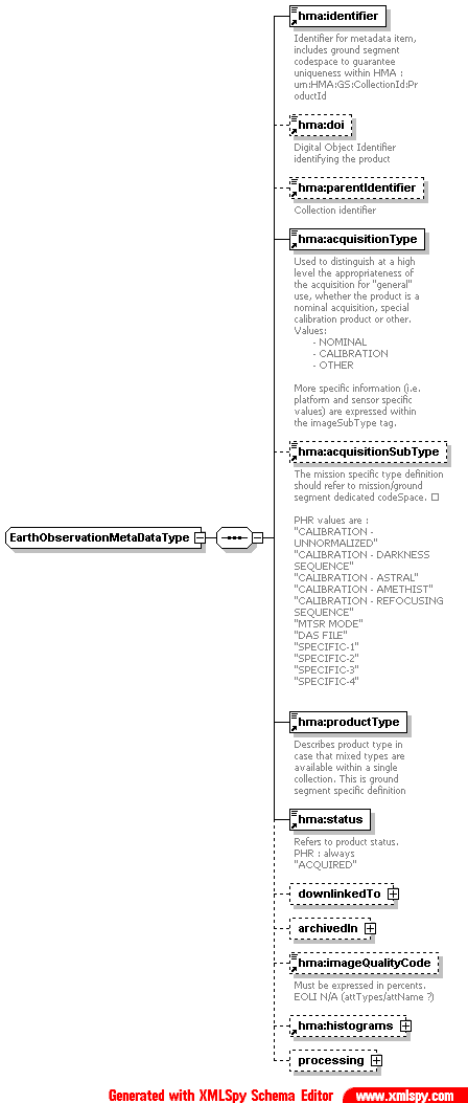

Figure 5 : <hma:EarthObservationMetadata> **diagram**

These metadata are mainly the *EarthObservation* identifier, the acquisition type and information relative to the downlink and archiving centers. Complete description of the *EarthObservationMetadata* is given in Table 4.

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
identifier	Identifier for metadata item, includes ground segment namespace to guarantee uniqueness within HMA		no	1
doi	Digital Object Identifier identifying the product (see http://www.doi.org)		no	0..1
parentIdentifier	Collection Identifier		no	0..1
acquisitionType	Used to distinguish at a high level the appropriateness of the acquisition for "general" use, whether the product is a nominal acquisition, special calibration product or other. Values: - NOMINAL - CALIBRATION - OTHER		no	1
acquisitionSubType	The broad value is however too restrictive, so mission specific type definition should refer to mission/ground segment dedicated codeSpace		no	0..1
productType	Describes product type in case that mixed types are available within a single collection, this is ground segment specific definition	MD_ContentInformation/ MD_CoverageDescription/ MD_CoverageContentType	no	0..1
status	Refers to product status. Values : - ARCHIVED - ACQUIRED - PLANNED - POTENTIAL	MD_Identification/ MD_ProgressCode	no	1
downlinkedTo/ DownlinkInformation/ acquisitionStation	Acquisition / receiving station code. Possible values are mission specific and should be retrieved using		no	1 (with AcquisitionInformation 0..n)

	codespace.			ormation 0..n)
downlinkedTo/ DownlinkInformation/ acquisitionDate	Acquisition date time.		no	0..1
archivedIn/ ArchivingInformation/ archivingCentre	Archiving centre code. Possible values are mission specific and should be retrieved using codeSpace.		no	1 (with ArchivingInformation 0..n)
archivedIn/ ArchivingInformation/ archivingDate	Archiving date time.		no	1
archivedIn/ ArchivingInformation/ archivingIdentifier	Local archiving id as created by the mission ground segment that may required to allow subsequent order processing		no	0..1
imageQualityDegradation	Quality degradation percentage (i.e. uom='%')		no	0..1
imageQualityDegradationQuotationMode	Indicator to know how the quality degradation percentage has been calculated. Value : AUTOMATIC, MANUAL		no	0..1
histograms/ Histogram/ bandId	Histrogram specific : identifier of the spectral band used to compute histogram values		no	0.. 1 (with Histogram 1..n)
histograms/ Histogram/ min	Histogram specific : minimum value		no	1
histograms/ Histogram/ max	Histogram specific : maximum value		no	1
histograms/ Histogram/ mean	Histogram specific : mean value		no	0..1
histograms/ Histogram/ stdDeviation	Histogram specific : standard deviation value		no	0..1
composedOf	Link to an EO product that is part of this EO		no	0..1

	product (e.g. a phr:DataStrip is composed of one or more phr:Scene)			
subsetOf	Link to the “father” EO product (e.g. a phr:Scene is a subset of a phr:DataStrip)		no	0..1
linkedWith	Specify a link to another EO product (e.g. ERS1 and ERS2 interferometric pair)		no	0..1
processing/ ProcessingInformation/ compositeType	Composite type of product, if available		no	0..n
processing/ ProcessingInformation/ method	Method used to compute datalayer. (e.g. Kalman filtering, ROSE)		no	0..n
processing/ ProcessingInformation/ methodVersion	Method version (e.g. 1.0)		no	0..n
processing/ ProcessingInformation/ processorName	Processor sofware name (e.g. FastROSE)		no	0..n
processing/ ProcessingInformation/ processorVersion	Processor software version (e.g. 1.0)		no	0..n
processing/ ProcessingInformation/ processingLevel	Processing level applied to the product		no	0..n
processing/ ProcessingInformation/ nativeProductFormat	Native product format		no	0..n
vendorSpecific/ SpecificInformation/ localAttribute	Container for ad-hoc metadata that does not merit a mission specific schema or extension, the localAttribute describes the name of the attribute		no	1 (with SpecificInformation 0..n)
vendorSpecific/ SpecificInformation/ localValue	Container for ad-hoc metadata that does not merit a mission specific schema or extension, the localAttribute describes the value of the attribute		no	1 (with SpecificInformation 0..n)

Table 4 : <*hma:EarthObservationMetadata*> fields description

7.1.2 EarthObservationEquipment

The *hma:EarthObservationEquipment* block contains metadata relative to the mechanism used during the *EarthObservation* (Figure 6).

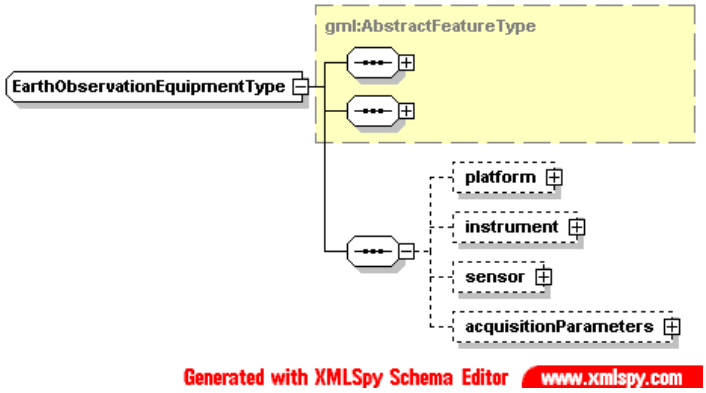

Figure 6 : <hma:EarthObservationEquipment> **diagram**

These metadata describe on one hand the platform, instrument and sensor used for the *Earthobservation*, and, on the other hand, the acquisition parameters of this observation. Complete description of the *EarthObservationEquipment* is given in Table 4.

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
platform/ Platform/ shortName	Platform short name (e.g. PHR)	MD_DataIdentification/ MI_DataIdentification/ MI_AcquisitionInformation/MI_PlatformIdentifictation/ shortName	yes	1
platform/ Platform/ serialIdentifier	Platform serial identifier (e.g. for PHR : 1A)	MD_DataIdentification/ MI_DataIdentification/ MI_AcquisitionInformation/MI_PlatformIdentifictation/ serialIdentifier	yes	0..1
platform/ Platform/ orbiteType	High level characterisation of main mission types (GEO/LEO)		no	0..1
instrument/ Instrument/ shortName	Instrument (Sensor) name	MD_DataIdentification/ MI_DataIdentification/ MI_AcquisitionInformation/	yes	1

shortName		MI_PlatformIdentifictation/ MI_InstrumentIdentification/ shortName		
sensor/ Sensor/ sensorType	Sensor type. This field should contain an enumeration : - OPTICAL - RADAR - ALTIMETRIC - ATMOSPHERIC	MD_CoverageDescription/ MI_CoverageDescription/ MI_Sensor/ sensorType	yes	0..1
sensor/ Sensor/ operationalMode	Sensor mode. Possible values are mission specific and should be retrieved using codeSpace. (e.g. PHR : PA, XS or PX).	MD_CoverageDescription/ MI_CoverageDescription/ MI_Sensor/ operationalMode	yes	0..1
sensor/ Sensor/ resolution	Sensor resolution.		no	0..1
sensor/ Sensor/ swathIdentifier	Swath identifier (e.g. Envisat ASAR has 7 distinct swaths (I1,I2,I3...I7) that correspond to precise incidence angles for the sensor). Value list can be retrieved with codeSpace.		no	0..1
acquisitionParameters/ Acquisition/ orbitNumber	Acquisition orbit number		no	0..1
acquisitionParameters/ Acquisition/ lastOrbitNumber	Acquisition last orbit number		no	0..1
acquisitionParameters/ Acquisition/ orbitDirection	Acquisition orbit direction (Ascending or descending)	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ platformDescending	no (keep text rather than boolean, prefer alignment with other acquisition parameters)	0..1
acquisitionParameters/ Acquisition/	UTC date and time at ascending node of		no	0..1

ascendingNodeDate	orbit			
acquisitionParameters/ Acquisition/ startTimeFromAscendingNode	Start time of acquisition in milliseconds from Ascending node date		no	0..1
acquisitionParameters/ Acquisition/ completionTimeFromAscendingNode	Stop time of acquisition in milliseconds from Ascending node date		no	0..1
acquisitionParameters/ Acquisition/ ascendingNodeLongitude	Longitude at ascending node of orbit		no	0..1
acquisitionParameters/ Acquisition/ orbitDuration	Actual orbit duration in milliseconds		no	0..1
acquisitionParameters/ Acquisition/ accrossTrackIncidenceAngle	Acquisition across the track incidence angle given in degrees (i.e. uom='deg')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ relativeAzimuth	no	0..1
acquisitionParameters/ Acquisition/ alongTrackIncidenceAngle	Acquisition along the track incidence angle given in degrees (i.e. uom='deg')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ TBD	no (consistency in HMA between two angle definitions)	0..1
acquisitionParameters/ Acquisition/ incidenceAngle	Acquisition global incidence angle given in degrees (i.e. uom='deg')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ TBD	no (consistency in HMA between two angle definitions)	0..1
acquisitionParameters/ Acquisition/ pitch	Satellite pitch angle given in degrees (i.e. uom='deg')		no	0..1
acquisitionParameters/ Acquisition/ roll	Satellite roll angle given in degrees (i.e. uom='deg')		no	0..1
acquisitionParameters/ Acquisition/ yaw	Satellite yaw angle given in degrees (i.e. uom='deg')		no	0..1

Table 5 : <hma:EarthObservationEquipment> **fields description**

7.1.3 Footprint

The *hma:Footprint* block contains description of the target location observed during the *EarthObservation* (Figure 7).

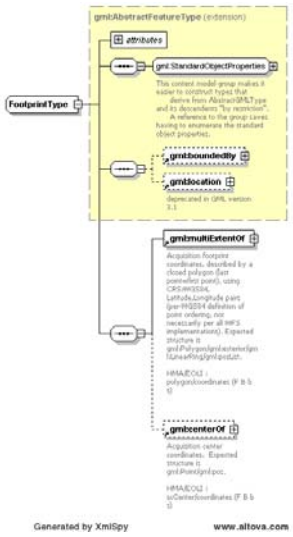

Figure 7 : <hma:Footprint> **diagram**

Complete description of *hma:Footprint* is given in Table 6.

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
multiExtentOf	Acquisition footprint coordinates, described by a closed polygon (last point=first point), using CRS:WGS84, Latitude,Longitude pairs (per-WGS84 definition of point ordering, not necessarily per all WFS implementations). Multi polygons are allowed.		no	1
centerOf	Acquisition centre coordinates	MD_CoverageDescription/ MI_CoverageDescription/ MD_ImageDescription/ MI_ImageDescription/ nadir	no	0..1

Table 6 : <hma:Footprint> **fields description**

7.1.4 EarthObservationResult

The *hma:EarthObservationResult* block contains description of the result of the *EarthObservation* (Figure 8).

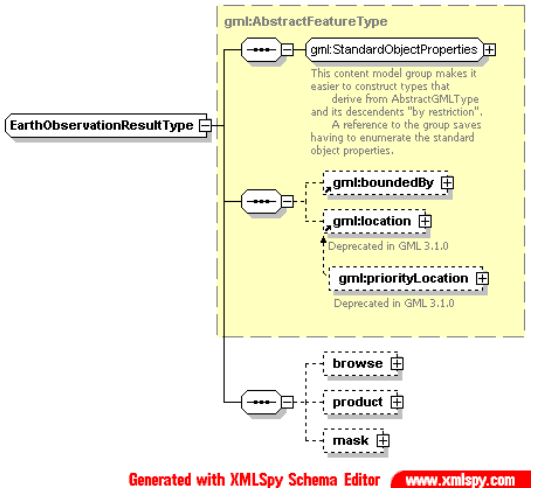

Figure 8 : <hma:EarthObservationResult> **diagram**

Complete description of *hma:Footprint* is given in Table 7.

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
browse/ BrowseInformation/ type	Browse type. Possible values are : - THUMBNAIL - QUICKLOOK - ALBUM.	MD_Identification/ MD_BrowseGraphic ?	no	1 (with browse 1..n)
browse/ BrowseInformation/ subType	Browse subType. Value is mission specific. Value list can be retrieved with codeSpace (e.g. For MODIS : OPTICAL, THERMAL)	MD_Identification/ MD_BrowseGraphic ?	no	0..1
browse/ BrowseInformation/ referenceSystemIdentifier	Indicates if browse is geo-referenced, and thus can be assumed to be displayed directly on a map (in which case should	MD_Identification/ MD_BrowseGraphic ?	no	1

	point to a code space for the CRS), when not supplied it is assumed that the browse is provided in "raw" satellite frame of reference			
browse/ BrowseInformation/ fileName	Path to the browse image (could be any kind of URL : direct link to the image or WMS/WCS interface), it is assumed that if a client is prepared to "manage" a browse delivered by e.g. WMS they would parse the URL to identify that it contains the OGC standard SERVICE=WMS	MD_Identification/ MD_BrowseGraphic/ fileName	yes	1
product/ ProductInformation/ fileName	Path to the actual product data if available online (could be any kind of URL : direct link to the image or WMS/WCS interface), it is assumed that if a client is prepared to "manage" a product delivered by e.g. WCS they would parse the URL to identify that it contains the OGC standard SERVICE=WCS	MD_ServiceIdentification	no (use filename definition as per browse)	0..1
product/ ProductInformation/ referenceSystemIdentifier	Indicates if product is geo-referenced, (in which case should point to a code space for the CRS), when not supplied it is assumed that the browse is provided in "raw" satellite frame of reference	MD_DataIdentification/ MD_SpatialRepresentationTypeCode (propose adding a code for un-georeferenced) (The CRS is part the geometry. Including it here will create maintenance difficulties)	no	0..1
product/ ProductInformation/ version	Product version	MD_DataIdentification supplementalInformation	no	0..1
product/ ProductInformation/ size	Product size (bytes) allowing the user to realise how long a download is likely to take	MD_DataIdentification supplementalInformation	no	0..1
mask/ MaskInformation/ type	Mask type. Possible values are : SNOW, CLOUD and QUALITY		no	1 (with

type	CLOUD and QUALITY			MaskInformation 0..n)
mask/ MaskInformation/ format	Mask format. Possible values are : RASTER or VECTOR		no	1 (with MaskInformation 0..n)
mask/ MaskInformation/ referenceSystemIdentifier	Indicates if maske is geo-referenced, and thus can be assumed to be displayed directly on a map (in which case should point to a code space for the CRS), when not supplied it is assumed that the mask is provided in "raw" satellite frame of reference		no	0..1
mask/ MaskInformation/ fileName	Path to the mask (could be any kind of URL : □direct link to the image or WMS/WCS interface in case of RASTER mask; direct link to the file or WFS interface in case of VECTOR file), it is assumed that if a client is prepared to "manage" a mask delivered by e.g. WMS they would parse the URL to identify that it contains the OGC standard SERVICE=WMS		no	1 (with MaskInformation 0..n)

Table 7 : <hma:EarthObservationResult> **fields description**

7.2 Thematic EO product data schema

The Thematic EO Product schemas provide the description of metadata common to thematic category of General EO Products derived. Thematic EO Products schemas extend the “hma” schema.

7.2.1 Optical EO Product data schema

The “ohr” schema provide the description of metadata common to all EO Products derived from optical satellite based remote sensing. It describes the same fields as the “hma” schema plus optical specific fields.

As described in §6.3.2.1, the root element of the "ohr" schema, named <ohr:EarthObservation> simply extends the <hma:EarthObservationType> type (with no element added) :

```
<xs:element name="EarthObservation" type="ohr:EarthObservationType"
            substitutionGroup="hma:EarthObservation"/>

<xs:complexType name="EarthObservationType">
    <xs:complexContent>
        <xs:extension base="hma:EarthObservationType">
            <xs:sequence/>
        </xs:extension>
    </xs:complexContent>
</xs:complexType>
```

Two properties are extended from the hma schema :

- *ohr:EarthObservationResults* extends *hma:EarthObservationResults* (Table 8);
- *ohr:Acquisition* extends *hma:Acquisition* (Table 9).

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
hma:EarthObservationEquipment/ hma:acquisitionParameters/ ohr:Acquisition/ ohr:illuminationAzimuthAngle	Azimuth angle given in degrees (i.e. uom='deg')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ illuminationAzimuth	yes	0..1
hma:EarthObservationEquipment/ hma:acquisitionParameters/ ohr:Acquisition/ ohr:illuminationElevationAngle	Elevation angle given in degrees (i.e. uom='deg')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ illuminationElevation	yes	0..1

Table 8 : <ohr:Acquisition> **extension of** <hma:Acquisition>

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality

ohr:EarthObservationResult/ ohr:cloudCoverPercentage	Cloud cover percentage (i.e. uom='%')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ cloudCoverPercentage	yes	0..1
ohr:EarthObservationResult/ ohr:cloudCoverPercentageAssessmentPercentage	Cloud cover assessment confidence. Expressed in percents.		no	0..1
ohr:EarthObservationResult/ ohr:cloudCoverPercentageQuotationMode	Indicator to know how the cloud cover percentage has been calculated Value : AUTOMATIC, MANUAL		no	0..1
ohr:EarthObservationResult/ ohr:snowCoverPercentage	Snow cover percentage (i.e. uom='%')		no	0..1
ohr:EarthObservationResult/ ohr:snowCoverPercentageAssessmentPercentage	Snow cover assessment confidence. Expressed in percents.		no	0..1
ohr:EarthObservationResult/ ohr:snowCoverPercentageQuotationMode	Indicator to know how the snow cover percentage has been calculated Value : AUTOMATIC, MANUAL		no	0..1

Table 9 : <ohr:EarthObservationResult> **extension of** <hma:EarthObservationResult>

7.2.2 Radar EO Product data schema

The "sar" schema provide the description of metadata common to all EO Products derived from radar satellite based remote sensing. It describes the same fields as the "hma" schema plus radar specific fields.

As described in §6.3.2.1, the root element of the "sar" schema, named <sar:EarthObservation> simply extends the <hma:EarthObservationType> type (with no element added) :


```
<xs:element name="EarthObservation" type="sar:EarthObservationType"
                substitutionGroup="hma:EarthObservation"/>

<xs:complexType name="EarthObservationType">
    <xs:complexContent>
        <xs:extension base="hma:EarthObservationType">
            <xs:sequence/>
        </xs:extension>
    </xs:complexContent>
</xs:complexType>
```

One property is extended from the hma schema :

- *sar:Acquisition* extends *hma:Acquisition* (Table 10).

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/ sar:polarisationMode	single S, dual D, twin T, quad Q, UNDEFINED Valids : D, Q, S, T, UNDEFINED	MD_CoverageDescription/ MD_RangeDimension/ MD_Band/ MI_Band/ MI_PolarizationCharacteristics	no	1
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/ sar:polarisationChannels	polarisation channel transmit/receive configuration: horizontal, vertical. Valids: - HH - HV - VH - VV - HH, VV - HH, VH - HH, HV - VH, VV - VH, HV - VV, HV - HH, VV, HV, VH - UNDEFINED	MD_CoverageDescription/ MD_RangeDimension/ MD_Band/ MI_Band/ MI_PolarizationCharacteristics	no	1
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/ sar:antennaLookDirection	LEFT or RIGHT		no	1
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/ sar:minimumIncidenceAngle	minimum incidence angle		no	1
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/	maximum incidence angle		no	1

sar:maximumIncidenceAngle				
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/ sar:incidenceAngleVariation	Incidence angle variation		no	1
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/ sar:dopplerFrequency	Doppler Frequency of acquisition		no	1

Table 10 : <sar:Acquisition> **extension of** <hma:Acquisition>

7.2.3 Atmospheric EO Product data schema

The "atm" schema provide the description of metadata common to all EO Products derived from atmospheric based remote sensing. It describes the same fields as the "hma" schema plus atmospheric specific fields.

As described in §6.3.2.1, the root element of the "atm" schema, named <atm:EarthObservation> simply extends the <hma:EarthObservationType> type (with no element added) :

```
<xs:element name="EarthObservation" type="atm:EarthObservationType"
                substitutionGroup="hma:EarthObservation"/>

<xs:complexType name="EarthObservationType">
    <xs:complexContent>
        <xs:extension base="hma:EarthObservationType">
            <xs:sequence/>
        </xs:extension>
    </xs:complexContent>
</xs:complexType>
```

One property is extended from the hma schema :

- *atm:EarthObservationResult* extends *hma:EarthObservationResult* (Table 11).

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
atm:EarthObservationResult/ atm:dataLayers/ atm:DataLayer/ atm:specy	Specy contained in dataLayer		no	1
atm:EarthObservationResult/ atm:dataLayers/	Unit of specy in dataLayer		no	1

atm:DataLayer/ atm:unit	dataLayer			
atm:EarthObservationResult/ atm:dataLayers/ atm:DataLayer/ atm:highestLocation	Top height of datalayer (in meters)	EX_VerticalExtent/ EE_VerticalExtentLocations/ highestLocation	yes	1
atm:EarthObservationResult/ atm:dataLayers/ atm:DataLayer/ atm:lowestLocation	Bottom height of datalayer (in meters)	EX_VerticalExtent/ EE_VerticalExtentLocations/ lowestLocation	yes	1
atm:EarthObservationResult/ atm:dataLayers/ atm:DataLayer/ atm:algorithmName	Name of algorithm used to compute datalayer		no	1
atm:EarthObservationResult/ atm:dataLayers/ atm:DataLayer/ atm:algorithmVersion	Algorithm version used to compute datalayer		no	1

Table 11 : <atm:EarthObservationResult> **extension of** <hma:EarthObservationResult>

7.2.4 Mission specific schema : example for Pleiades HR data schema

The "phr" schema provide the description of Pleiades HR public metadata. It derived from optical EO product.

As described in §6.3.2.2, the root element of the "phr" schema, named <phr:DataStrip> simply extends the <hma:EarthObservationType> type (with no element added) with the addition of the hma:type attribute :

```
<xs:element name="DataStrip" type="phr:DataStripType"
                substitutionGroup="ohr:EarthObservation"/>

<xs:complexType name="DataStripType">
    <xs:complexContent>
        <xs:extension base="ohr:EarthObservationType">
            <xs:sequence/>
            <xs:attribute ref="hma:type" use="required"/>
        </xs:extension>
    </xs:complexContent>
</xs:complexType>
```

PHR taxonomy, and mission specific taxonomy in general, is out of the scope of this document and is not described in this document.

7.3 Issues

GML is a complex specification that is richly expressive. The Earth Observation Products does not exploit the entire specification but employ a subset of constructs corresponding to its relevant requirements.

As a consequence, the Earth Observation application schema used a GML subset instead of the complete GML definition (see Annex E). The use of this GML subset is recommended to simplify the developpement of computer application dealing with Earth Observation Product schemas (client-side or server-side applications).

7.4 XML schema documents

The different GML application schema are specified in the normative XML Schema Documents included in the zip file with this text document, which are named:

a) hma.xsd

b) atm.xsd

c) ohr.xsd

d) sar.xsd

e) phr_datastrip.xsd

f) phr_scene.xsd

All these XML Schema Documents contain documentation of the meaning of each element and attribute, and this documentation shall be considered normative as specified in Subclause 11.6.3 of [OGC 05-008].

These XML Schema Documents are bundled in a zip file with this document. After OGC acceptance of a Version 1.0.0 of this specification, these XML Schema Documents will also be posted online at the URL http://bp.schemas.opengis.net/06-080r2/. In the event of a discrepancy between the bundled and online versions of the XML Schema Documents, the online files shall be considered authoritative.

Annex A
(normative)

Abstract test suite

An abstract test suite is not provided in this version of this Implementation Specification, but will be provided in version 1.0.0.

Annex B
(normative)

Examples using “hma” application schema

B.1 Introduction

This annex contains several example XML documents encoded using the “hma” application schema.

B.2 Example of “hma” EO Product

```
<?xml version="1.0" encoding="utf-8"?>
<?xml-stylesheet type="text/xsl" href="schematron_result_for_hma_gml_observation.xsl"?>
<ohr:EarthObservation gml:id="DS_PHR1A_20010822110247_TLS_PX_E123N45_0101_01234"
xmlns:gml="http://www.opengis.net/gml" xmlns:hma="http://earth.esa.int/hma"
xmlns:ohr="http://earth.esa.int/ohr" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://earth.esa.int/ohr
../../hma/1.0/ohr.xsd">
    <gml:metaDataProperty>
        <hma:EarthObservationMetaData>

    <hma:identifier>DS_PHR1A_20010822110247_TLS_PX_E123N45_0101_01234</hma:identifier>
            <hma:acquisitionType>NOMINAL</hma:acquisitionType>
            <hma:productType>TBD</hma:productType>
            <hma:status>ACQUIRED</hma:status>
            <hma:downlinkedTo>
                <hma:DownlinkInformation>
                    <hma:acquisitionStation
codeSpace="urn:HMA:PHR:stationCode">TLS</hma:acquisitionStation>
                </hma:DownlinkInformation>
            </hma:downlinkedTo>
            <hma:archivedIn>
                <hma:ArchivingInformation>
                    <hma:archivingCenter
codeSpace="urn:HMA:PHR:stationCode">TLS</hma:archivingCenter>
                    <hma:archivingDate>2001-08-22T11:02:47.999</hma:archivingDate>
                </hma:ArchivingInformation>
            </hma:archivedIn>
            <hma:imageQualityDegradation uom="%">0</hma:imageQualityDegradation>
            <hma:processing>
                <hma:ProcessingInformation/>
            </hma:processing>
        </hma:EarthObservationMetaData>
    </gml:metaDataProperty>
    <gml:validTime>
        <gml:TimePeriod>
            <gml:beginPosition>2001-08-22T11:02:47.000</gml:beginPosition>
            <gml:endPosition>2001-08-22T11:02:47.999</gml:endPosition>
        </gml:TimePeriod>
    </gml:validTime>
    <gml:using>
        <hma:EarthObservationEquipment>
            <hma:platform>
                <hma:Platform>
```

```
                    <hma:shortName>PHR</hma:shortName>
                    <hma:serialIdentifier>1A</hma:serialIdentifier>
                </hma:Platform>
            </hma:platform>
            <hma:instrument>
                <hma:Instrument>
                    <hma:shortName>PHR</hma:shortName>
                </hma:Instrument>
            </hma:instrument>
            <hma:sensor>
                <hma:Sensor>
                    <hma:sensorType>OPTICAL</hma:sensorType>
                    <hma:operationalMode
codeSpace="urn:HMA:PHR:sensorMode">PX</hma:operationalMode>
                    <hma:resolution uom="m">0.7</hma:resolution>
                </hma:Sensor>
            </hma:sensor>
            <hma:acquisitionParameters>
                <ohr:Acquisition>
                    <hma:orbitNumber>12</hma:orbitNumber>
                    <hma:lastOrbitNumber>12</hma:lastOrbitNumber>
                    <hma:orbitDirection>ASCENDING</hma:orbitDirection>
                    <hma:acrossTrackIncidenceAngle uom="deg">-14.0</hma:acrossTrackIncidenceAngle>
                    <hma:alongTrackIncidenceAngle uom="deg">-13.9</hma:alongTrackIncidenceAngle>
                    <hma:pitch uom="deg">0</hma:pitch>
                    <hma:roll uom="deg">0</hma:roll>
                    <hma:yaw uom="deg">0</hma:yaw>
                    <ohr:illuminationAzimuthAngle uom="deg">10</ohr:illuminationAzimuthAngle>
                </ohr:Acquisition>
            </hma:acquisitionParameters>
        </hma:EarthObservationEquipment>
    </gml:using>
    <gml:target>
        <hma:Footprint>
            <gml:multiExtentOf>
                <gml:MultiSurface srsName="EPSG:4326">
                    <gml:surfaceMembers>
                        <gml:Polygon srsName="EPSG:4326">
                            <gml:exterior>
                                <gml:LinearRing>
                                    <gml:posList>2.1025 43.516667 2.861667 43.381667 2.65 42.862778
1.896944 42.996389 2.1025 43.516667</gml:posList>
                                </gml:LinearRing>
                            </gml:exterior>
                        </gml:Polygon>
                    </gml:surfaceMembers>
                </gml:MultiSurface>
            </gml:multiExtentOf>
            <gml:centerOf>
                <gml:Point srsName="EPSG:4326">
                    <gml:pos>2.374167 43.190833</gml:pos>
                </gml:Point>
            </gml:centerOf>
        </hma:Footprint>
    </gml:target>
    <gml:resultOf>
        <ohr:EarthObservationResult>
            <hma:browse>
                <hma:BrowseInformation>
                    <hma:type>QUICKLOOK</hma:type>
                    <hma:referenceSystemIdentifier
codeSpace="EPSG">epsg:4326</hma:referenceSystemIdentifier>
```

```
    <hma:fileName>http://hma.cnes.fr/catalog/DS_PHR1A_20010822110247_TLS_PX_E123N45_0101_01
234.jpg</hma:fileName>
                </hma:BrowseInformation>
            </hma:browse>
            <hma:mask>
                <hma:MaskInformation>
                    <hma:type>CLOUD</hma:type>
                    <hma:format>VECTOR</hma:format>

    <hma:fileName>http://hma.cnes.fr/catalog/DS_PHR1A_20010822110247_TLS_PX_E123N45_0101_01
234.gml</hma:fileName>
                </hma:MaskInformation>
            </hma:mask>
            <ohr:cloudCoverPercentage uom="%">30</ohr:cloudCoverPercentage>
        </ohr:EarthObservationResult>
    </gml:resultOf>
</ohr:EarthObservation>
```

B.3 Example of a “phr” EO Product

TBD

Annex C
(normative)

Reference schemas for EO Products GML application schemas

D.1 Application schema for General EO Products

The following schema document, called *hma.xsd*, contains elements to describe General EO Products using GML 3.1.1

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSPY v2004 rel. 2 U (http://www.xmlspy.com) by jrom (CNES) -->
<xs:schema xmlns:om="http://www.opengis.net/om" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml" xmlns:hma="http://earth.esa.int/hma"
targetNamespace="http://earth.esa.int/hma" elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0">
	<xs:import namespace="http://www.opengis.net/gml" schemaLocation="../../gml/3.1.1/base/gmlSubset.xsd"/>
	<xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="../../xlink/1.0.0/xlinks.xsd"/>
	<!-- ========================================================================== -->
	<!--  EarthObservation : -->
	<!--		+ Inherits from gml:AbstractObservation -->
	<!-- ========================================================================== -->
	<xs:element name="EarthObservation" type="hma:EarthObservationType" substitutionGroup="gml:Observation">
		<xs:annotation>
			<xs:documentation>HMA root element for generic Earth Observation Product description</xs:documentation>
		</xs:annotation>
	</xs:element>
	<xs:complexType name="EarthObservationType">
		<xs:annotation>
			<xs:documentation>Earth Obervation Product description</xs:documentation>
		</xs:annotation>
		<xs:complexContent>
			<xs:extension base="gml:ObservationType"/>
		</xs:complexContent>
	</xs:complexType>
	<xs:complexType name="EarthObservationPropertyType">
		<xs:sequence>
			<xs:element ref="hma:EarthObservation" minOccurs="0"/>
		</xs:sequence>
		<xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
	</xs:complexType>
	<!-- ========================================================================== -->
	<!--  EarthObservationEquipment : -->
	<!--		+ made of Platform / Instrument / Sensor / Acquisition  -->
	<!--		+ should be found within EarthObservation "using" property -->
	<!-- ========================================================================== -->
	<xs:element name="EarthObservationEquipment" type="hma:EarthObservationEquipmentType"
substitutionGroup="gml:_Feature"/>
	<xs:complexType name="EarthObservationEquipmentType">
		<xs:complexContent>
			<xs:extension base="gml:AbstractFeatureType">
				<xs:sequence>
					<xs:element name="platform" type="hma:PlatformPropertyType" minOccurs="0"/>
					<xs:element name="instrument" type="hma:InstrumentPropertyType" minOccurs="0"/>
					<xs:element name="sensor" type="hma:SensorPropertyType" minOccurs="0"/>
					<xs:element name="acquisitionParameters" type="hma:AcquisitionPropertyType" minOccurs="0"/>
				</xs:sequence>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
	<xs:complexType name="EarthObservationEquipmentPropertyType">
		<xs:sequence>
```

```
                <xs:element ref="hma:EarthObservationEquipment"/>
            </xs:sequence>
        </xs:complexType>
        <!-- ============================================================================== -->
        <!--  hma:type :  -->
        <!--            + should be used in extended schema within extended element  -->
        <!--              e.g. : phr:EarthObservation inherits from ohr:EarthObservation. -->
        <!--                     the client processing the data should understand that phr:Acquisition extends ohr:Acquisition. -->
        <!--                     using the attribute hma:type : -->
        <!--                     <phr:Acquisition hma:type="ohr:Acquisition"/>...</phr:Acquisition> -->
        <!-- ============================================================================== -->
        <xs:attribute name="type" type="xs:QName"/>
        <!-- ============================================================================== -->
        <!--  Archiving Information :  -->
        <!--            + referenced within the hma:EarthObservationMetadata "archivedIn" property -->
        <!-- ============================================================================== -->
        <xs:element name="ArchivingInformation" type="hma:ArchivingInformationType"/>
        <xs:complexType name="ArchivingInformationArrayPropertyType">
            <xs:sequence>
                <xs:element ref="hma:ArchivingInformation" maxOccurs="unbounded"/>
            </xs:sequence>
        </xs:complexType>
        <xs:complexType name="ArchivingInformationType">
            <xs:sequence>
                <xs:element name="archivingCenter" type="gml:CodeListType">
                    <xs:annotation>
                        <xs:documentation>Archiving centre code. Possible values are mission specific
and should be retrieved using codespace.

PHR : value is a valid station code
HMA/EOLI : N/A</xs:documentation>
                    </xs:annotation>
                </xs:element>
                <xs:element name="archivingDate" type="xs:dateTime">
                    <xs:annotation>
                        <xs:documentation>Archiving date time</xs:documentation>
                    </xs:annotation>
                </xs:element>
                <xs:element name="archivingIdentifier" type="hma:CodeWithAuthorityType" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>Local archiving id as created by the mission ground segment that may required to
allow subsequent order processing</xs:documentation>
                    </xs:annotation>
                </xs:element>
            </xs:sequence>
        </xs:complexType>
        <!-- ============================================================================== -->
        <!--  Downlink Information : -->
        <!--            + referenced within the hma:EarthObservationMetadata "downlinkedTo" property -->
        <!-- ============================================================================== -->
        <xs:element name="DownlinkInformation" type="hma:DownlinkInformationType"/>
        <xs:complexType name="DownlinkInformationArrayPropertyType">
            <xs:sequence>
                <xs:element ref="hma:DownlinkInformation" maxOccurs="unbounded"/>
            </xs:sequence>
        </xs:complexType>
        <xs:complexType name="DownlinkInformationType">
            <xs:sequence>
                <xs:element name="acquisitionStation" type="gml:CodeListType">
                    <xs:annotation>
                        <xs:documentation>Acquisition / receiving station code. Possible values are mission specific and
should be retrieved using codespace.</xs:documentation>
                    </xs:annotation>
                </xs:element>
                <xs:element name="acquisitionDate" type="xs:dateTime" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>Acquisition date time</xs:documentation>
                    </xs:annotation>
                </xs:element>
            </xs:sequence>
        </xs:complexType>
```

```
        <!-- ============================================================================ -->
        <!--   EarthObservationMetaData : -->
        <!--            + contains properties that do not fit directly inside the observation structure -->
        <!--            + should be under EarthObservation "gml:metadaProperty" property -->
        <!-- ============================================================================ -->
        <xs:element name="EarthObservationMetaData" type="hma:EarthObservationMetaDataType"
substitutionGroup="gml:_MetaData"/>
        <xs:complexType name="EarthObservationMetaDataType" mixed="true">
                <xs:complexContent mixed="true">
                        <xs:extension base="gml:AbstractMetaDataType">
                                <xs:sequence>
                                        <xs:element ref="hma:identifier"/>
                                        <xs:element ref="hma:doi" minOccurs="0"/>
                                        <xs:element ref="hma:parentIdentifier" minOccurs="0"/>
                                        <xs:element ref="hma:acquisitionType"/>
                                        <xs:element ref="hma:acquisitionSubType" minOccurs="0"/>
                                        <xs:element ref="hma:productType"/>
                                        <xs:element ref="hma:status"/>
                                        <xs:element name="downlinkedTo" type="hma:DownlinkInformationArrayPropertyType"
minOccurs="0"/>
                                        <xs:element name="archivedIn" type="hma:ArchivingInformationArrayPropertyType"
minOccurs="0"/>
                                        <xs:element ref="hma:imageQualityDegradation" minOccurs="0"/>
                                        <xs:element ref="hma:imageQualityDegradationQuotationMode" minOccurs="0"/>
                                        <xs:element ref="hma:histograms" minOccurs="0"/>
                                        <xs:element ref="hma:composedOf" minOccurs="0" maxOccurs="unbounded"/>
                                        <xs:element ref="hma:subsetOf" minOccurs="0" maxOccurs="unbounded"/>
                                        <xs:element ref="hma:linkedWith" minOccurs="0" maxOccurs="unbounded"/>
                                        <xs:element name="processing" type="hma:ProcessingInformationPropertyType" minOccurs="0"/>
                                        <xs:element name="vendorSpecific" type="hma:SpecificInformationArrayPropertyType"
minOccurs="0"/>
                                </xs:sequence>
                        </xs:extension>
                </xs:complexContent>
        </xs:complexType>
        <!-- ============================================================================ -->
        <!--   Acquisition : -->
        <!--            + referenced within the EarthObservationEquipment -->
        <!-- ============================================================================ -->
        <xs:element name="Acquisition" type="hma:AcquisitionType"/>
        <xs:complexType name="AcquisitionPropertyType">
                <xs:sequence>
                        <xs:element ref="hma:Acquisition"/>
                </xs:sequence>
        </xs:complexType>
        <xs:complexType name="AcquisitionType">
                <xs:sequence>
                        <xs:element name="orbitNumber" type="xs:int" minOccurs="0">
                                <xs:annotation>
                                        <xs:documentation>EOLI : orbit (F B b s)</xs:documentation>
                                </xs:annotation>
                        </xs:element>
                        <xs:element name="lastOrbitNumber" type="xs:int" minOccurs="0">
                                <xs:annotation>
                                        <xs:documentation>EOLI : lastOrbit (F)</xs:documentation>
                                </xs:annotation>
                        </xs:element>
                        <xs:element name="orbitDirection" minOccurs="0">
                                <xs:annotation>
                                        <xs:documentation>EOLI : orbitDir (F B b s)</xs:documentation>
                                </xs:annotation>
                                <xs:simpleType>
                                        <xs:restriction base="xs:string">
                                                <xs:enumeration value="ASCENDING"/>
                                                <xs:enumeration value="DESCENDING"/>
                                        </xs:restriction>
                                </xs:simpleType>
                        </xs:element>
                        <xs:element name="ascendingNodeDate" type="xs:dateTime" minOccurs="0">
                                <xs:annotation>
                                        <xs:documentation>UTC date and time at ascending node of orbit</xs:documentation>
```

```
                </xs:annotation>
            </xs:element>
            <xs:element name="ascendingNodeLongitude" type="xs:double" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Longitude at ascending node of orbit</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="orbitDuration" type="xs:double" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Actual orbit duration in milliseconds</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="acrossTrackIncidenceAngle" type="gml:AngleType" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Across Track Incidence angle given in degrees.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="alongTrackIncidenceAngle" type="gml:AngleType" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Along Track Incidence angle given in degrees.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="incidenceAngle" type="gml:AngleType" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Global Incidence angle given in degrees.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="pitch" type="gml:AngleType" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Pitch angle given in degrees.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="roll" type="gml:AngleType" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Roll angle given in degrees.</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="yaw" type="gml:AngleType" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Yaw angle given in degrees.</xs:documentation>
                </xs:annotation>
            </xs:element>
        </xs:sequence>
    </xs:complexType>
    <!-- ========================================================================== -->
    <!--  Platform / Instrument / Sensor / Acquisition : -->
    <!--          + should be found within EarthObservation : -->
    <!--                              - "procedure" property (O&M Observation mapping) -->
    <!--                              - "using" property (GML Observation mapping) -->
    <!-- ========================================================================== -->
    <xs:complexType name="PlatformPropertyType">
        <xs:sequence>
            <xs:element ref="hma:Platform"/>
        </xs:sequence>
    </xs:complexType>
    <xs:complexType name="InstrumentPropertyType">
        <xs:sequence>
            <xs:element ref="hma:Instrument"/>
        </xs:sequence>
    </xs:complexType>
    <xs:complexType name="SensorPropertyType">
        <xs:sequence>
            <xs:element ref="hma:Sensor"/>
        </xs:sequence>
    </xs:complexType>
    <xs:element name="Platform" type="hma:PlatformType"/>
    <xs:complexType name="PlatformType">
        <xs:sequence>
            <xs:element name="shortName" type="xs:string">
                <xs:annotation>
                    <xs:documentation>Platform short name (eg. PHR) </xs:documentation>
```

```
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="serialIdentifier" type="xs:string" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Platform serial identifier (eg. for PHR : 1A)</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="orbitType" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>High level characterisation of main mission types
(GEO/LEO)</xs:documentation>
                        </xs:annotation>
                        <xs:simpleType>
                            <xs:restriction base="xs:string">
                                <xs:enumeration value="GEO"/>
                                <xs:enumeration value="LEO"/>
                            </xs:restriction>
                        </xs:simpleType>
                    </xs:element>
                </xs:sequence>
            </xs:complexType>
            <xs:element name="Instrument" type="hma:InstrumentType"/>
            <xs:complexType name="InstrumentType">
                <xs:sequence>
                    <xs:element name="shortName" type="xs:string">
                        <xs:annotation>
                            <xs:documentation>Instrument short name

EOLI : instShNm</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                </xs:sequence>
            </xs:complexType>
            <xs:element name="Sensor" type="hma:SensorType"/>
            <xs:complexType name="SensorType">
                <xs:sequence>
                    <xs:element name="sensorType" type="hma:SensorTypePropertyType" minOccurs="0"/>
                    <xs:element name="operationalMode" type="gml:CodeListType" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Sensor mode. Possible values are mission specific and should
be retrieved using codespace. (eg. PHR : PA, XS or PX).</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="resolution" type="gml:MeasureType" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Image resolution</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="swathIdentifier" type="gml:CodeListType" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Swath identifier (e.g. Envisat ASAR has 7 distinct swaths (I1,I2,I3...I7) that
correspond to precise incidence angles for the sensor). Value list can be retrieved with codeSpace.</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                </xs:sequence>
            </xs:complexType>
            <xs:simpleType name="SensorTypePropertyType">
                <xs:restriction base="xs:string">
                    <xs:enumeration value="ALTIMETRIC"/>
                    <xs:enumeration value="ATMOSPHERIC"/>
                    <xs:enumeration value="OPTICAL"/>
                    <xs:enumeration value="RADAR"/>
                </xs:restriction>
            </xs:simpleType>
            <!-- ========================================================================== -->
            <!--  EarthObservationResult Feature : -->
            <!--          + this feature defines the observation result, i.e. the Earth Observation Product -->
            <!--          + should be found within EarthObservation "result" property -->
            <!-- ========================================================================== -->
            <xs:element name="EarthObservationResult" type="hma:EarthObservationResultType" substitutionGroup="gml:_Feature">
                <xs:annotation>
```

```
                <xs:documentation>Defines the observation result, i.e. the Earth Observation Product</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:complexType name="EarthObservationResultType">
            <xs:complexContent>
                <xs:extension base="gml:AbstractFeatureType">
                    <xs:sequence>
                        <xs:element name="browse" type="hma:BrowseInformationArrayPropertyType" minOccurs="0"/>
                        <xs:element name="product" type="hma:ProductInformationArrayPropertyType" minOccurs="0"/>
                        <xs:element name="mask" type="hma:MaskInformationArrayPropertyType" minOccurs="0"/>
                    </xs:sequence>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
        <xs:complexType name="EarthObservationResultPropertyType">
            <xs:sequence>
                <xs:element ref="hma:EarthObservationResult"/>
            </xs:sequence>
        </xs:complexType>
        <!-- ========================================================================== -->
        <!--  Footprint  Feature : -->
        <!--          + this feature defines the acquisition footprint i.e. what is observed by the Instrument -->
        <!--          + should be found within EarthObservation "featureOfInterest" property -->
        <!-- ========================================================================== -->
        <xs:element name="Footprint" type="hma:FootprintType" substitutionGroup="gml:_Feature">
            <xs:annotation>
                <xs:documentation>Defines the acquisition footprint, i.e. the region observed by the
Instrument</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:complexType name="FootprintType">
            <xs:complexContent>
                <xs:extension base="gml:AbstractFeatureType">
                    <xs:sequence>
                        <xs:element ref="gml:multiExtentOf">
                            <xs:annotation>
                                <xs:documentation>Acquisition footprint coordinates, described by a closed polygon (last
point=first point), using CRS:WGS84, Latitude,Longitude pairs (per-WGS84 definition of point ordering, not necessarily per all WFS
implementations). Expected structure is gml:Polygon/gml:exterior/gml:LinearRing/gml:posList.

HMA/EOLI : polygon/coordinates (F B b s)
                                </xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element ref="gml:centerOf" minOccurs="0">
                            <xs:annotation>
                                <xs:documentation>Acquisition center coordinates.  Expected structure is
gml:Point/gml:pos.

HMA/EOLI : scCenter/coordinates (F B b s)</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                    </xs:sequence>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
        <!-- ========================================================================== -->
        <!--  BrowseInformation  -->
        <!-- ========================================================================== -->
        <xs:complexType name="BrowseInformationArrayPropertyType">
            <xs:sequence>
                <xs:element ref="hma:BrowseInformation" maxOccurs="unbounded"/>
            </xs:sequence>
        </xs:complexType>
        <xs:element name="BrowseInformation" type="hma:BrowseInformationType"/>
        <xs:complexType name="BrowseInformationType">
            <xs:sequence>
                <xs:element name="type">
                    <xs:annotation>
                        <xs:documentation>Browse type. Possible values are : THUMBNAIL, QUICKLOOK and ALBUM.
</xs:documentation>
```

```
                        </xs:annotation>
                        <xs:simpleType>
                            <xs:restriction base="xs:string">
                                <xs:enumeration value="THUMBNAIL"/>
                                <xs:enumeration value="QUICKLOOK"/>
                                <xs:enumeration value="ALBUM"/>
                            </xs:restriction>
                        </xs:simpleType>
                    </xs:element>
                    <xs:element name="subType" type="gml:CodeListType" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Value is mission specific. Value list can be retrieved with codeSpace. Not used by
PHR. For MODIS : OPTICAL, THERMAL</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="referenceSystemIdentifier" type="hma:CodeWithAuthorityType">
                        <xs:annotation>
                            <xs:documentation>Indicates if browse is geo-referenced, and thus can be assumed to be displayed
directly on a map (in which case should point to a code space for the CRS), when not supplied it is assumed that the browse is
provided in "raw" satellite frame of reference</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="fileName" type="xs:string">
                        <xs:annotation>
                            <xs:documentation>Path to the browse image (could be any kind of URL :
direct link to the image or WMS/WCS interface), it is assumed that if a client is prepared to "manage" a browse delivered by e.g.
WMS they would parse the URL to identify that it contains the OGC standard SERVICE=WMS</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                </xs:sequence>
            </xs:complexType>
            <!-- ========================================================================== -->
            <!--   ProductInformation  -->
            <!-- ========================================================================== -->
            <xs:complexType name="ProductInformationArrayPropertyType">
                <xs:sequence>
                    <xs:element ref="hma:ProductInformation" maxOccurs="unbounded"/>
                </xs:sequence>
            </xs:complexType>
            <xs:element name="ProductInformation" type="hma:ProductInformationType"/>
            <xs:complexType name="ProductInformationType">
                <xs:sequence>
                    <xs:element name="referenceSystemIdentifier" type="hma:CodeWithAuthorityType" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Indicates if product is geo-referenced, (in which case should point to a code space
for the CRS), when not supplied it is assumed that the browse is provided in "raw" satellite frame of reference</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="fileName" type="xs:string">
                        <xs:annotation>
                            <xs:documentation>Path to the actual product data if available online (could be any kind of URL :
direct link to the image or WMS/WCS interface), it is assumed that if a client is prepared to "manage" a product delivered by e.g.
WCS they would parse the URL to identify that it contains the OGC standard SERVICE=WCS</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="version" type="xs:string" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Product version</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="size" type="gml:MeasureListType" minOccurs="0">
                        <xs:annotation>
                            <xs:documentation>Product size (bytes) allowing the user to realise how long a download is likely to
take</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                </xs:sequence>
            </xs:complexType>
            <!-- ========================================================================== -->
            <!--   Processing Information  -->
            <!-- ========================================================================== -->
```

```
<xs:complexType name="ProcessingInformationPropertyType">
	<xs:sequence>
		<xs:element ref="hma:ProcessingInformation"/>
	</xs:sequence>
</xs:complexType>
<xs:element name="ProcessingInformation" type="hma:ProcessingInformationType"/>
<xs:complexType name="ProcessingInformationType">
	<xs:sequence>
		<xs:element name="compositeType" minOccurs="0">
			<xs:annotation>
				<xs:documentation>Composite type of product, if available</xs:documentation>
			</xs:annotation>
			<xs:simpleType>
				<xs:restriction base="xs:string">
					<xs:enumeration value="DAILY"/>
					<xs:enumeration value="WEEKLY"/>
					<xs:enumeration value="MONTHLY"/>
					<xs:enumeration value=""/>
				</xs:restriction>
			</xs:simpleType>
		</xs:element>
		<xs:element name="method" type="xs:string" minOccurs="0">
			<xs:annotation>
				<xs:documentation>Method used to compute datalayer. (e.g. Kalman filtering,
ROSE)</xs:documentation>
			</xs:annotation>
		</xs:element>
		<xs:element name="methodVersion" type="xs:string" minOccurs="0">
			<xs:annotation>
				<xs:documentation>Method version (e.g. 1.0)</xs:documentation>
			</xs:annotation>
		</xs:element>
		<xs:element name="processorName" type="xs:string" minOccurs="0">
			<xs:annotation>
				<xs:documentation>Processor sofware name (e.g. FastROSE)</xs:documentation>
			</xs:annotation>
		</xs:element>
		<xs:element name="processorVersion" type="xs:string" minOccurs="0">
			<xs:annotation>
				<xs:documentation>Processor software version (e.g. 1.0)</xs:documentation>
			</xs:annotation>
		</xs:element>
		<xs:element name="processingLevel" minOccurs="0">
			<xs:annotation>
				<xs:documentation>Processing level applied to the product</xs:documentation>
			</xs:annotation>
			<xs:simpleType>
				<xs:restriction base="xs:string">
					<xs:enumeration value="1A"/>
					<xs:enumeration value="1B"/>
					<xs:enumeration value="2"/>
					<xs:enumeration value="3"/>
				</xs:restriction>
			</xs:simpleType>
		</xs:element>
		<xs:element name="nativeProductFormat" type="xs:string" minOccurs="0">
			<xs:annotation>
				<xs:documentation>Native product format</xs:documentation>
			</xs:annotation>
		</xs:element>
	</xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<!--   Histograms  -->
<!-- ========================================================================== -->
<xs:element name="histograms" type="hma:HistogramArrayPropertyType"/>
<xs:element name="Histogram" type="hma:HistogramType" substitutionGroup="gml:_Object"/>
<xs:complexType name="HistogramArrayPropertyType">
	<xs:sequence>
		<xs:element ref="hma:Histogram" maxOccurs="unbounded"/>
	</xs:sequence>
```

```
    </xs:complexType>
    <xs:complexType name="HistogramType">
        <xs:sequence>
            <xs:element name="bandId" type="xs:string" minOccurs="0"/>
            <xs:element name="min" type="xs:int"/>
            <xs:element name="max" type="xs:int"/>
            <xs:element name="mean" type="xs:double" minOccurs="0"/>
            <xs:element name="stdDeviation" type="xs:double" minOccurs="0"/>
        </xs:sequence>
    </xs:complexType>
    <!-- ========================================================================== -->
    <!--   Masks information  -->
    <!-- ========================================================================== -->
    <xs:complexType name="MaskInformationArrayPropertyType">
        <xs:sequence>
            <xs:element ref="hma:MaskInformation" maxOccurs="unbounded"/>
        </xs:sequence>
    </xs:complexType>
    <xs:element name="MaskInformation" type="hma:MaskInformationType"/>
    <xs:complexType name="MaskInformationType">
        <xs:sequence>
            <xs:element name="type">
                <xs:annotation>
                    <xs:documentation>Mask type. Possible values are : SNOW, CLOUD and
QUALITY</xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="SNOW"/>
                        <xs:enumeration value="CLOUD"/>
                        <xs:enumeration value="QUALITY"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="format">
                <xs:annotation>
                    <xs:documentation>Mask format. Possible values are : RASTER or VECTOR</xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="RASTER"/>
                        <xs:enumeration value="VECTOR"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="referenceSystemIdentifier" type="hma:CodeWithAuthorityType" minOccurs="0">
                <xs:annotation>
                    <xs:documentation>Indicates if mask is geo-referenced, and thus can be assumed to be displayed
directly on a map (in which case should point to a code space for the CRS), when not supplied it is assumed that the mask is provided
in "raw" satellite frame of reference</xs:documentation>
                </xs:annotation>
            </xs:element>
            <xs:element name="fileName" type="xs:string">
                <xs:annotation>
                    <xs:documentation>Path to the mask (could be any kind of URL :
direct link to the image or WMS/WCS interface in case of RASTER mask; direct link to the file or WFS interface in case of VECTOR
file), it is assumed that if a client is prepared to "manage" a mask delivered by e.g. WMS they would parse the URL to identify that it
contains the OGC standard SERVICE=WMS</xs:documentation>
                </xs:annotation>
            </xs:element>
        </xs:sequence>
    </xs:complexType>
    <!-- -->
    <!-- -->
    <!-- ========================================================================== -->
    <!--   Mask  Feature  -->
    <!-- ========================================================================== -->
    <xs:element name="Mask" type="hma:MaskType" substitutionGroup="gml:_Feature">
        <xs:annotation>
```

```
                <xs:documentation>Mask defined as a feature collection (in the GML 3.2 sense : a feature collection is a feature
having a property derived by extension from gml:AbstractFeatureMemberType). Mandates the following optional gml properties
inherited from gml:_Feature :
- gml:id attribute
- gml:name
- gml:boundedBy

Note : the upcoming gml:identifier will replace hma:identifier in GML 3.2</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:complexType name="MaskType">
            <xs:complexContent>
                <xs:extension base="gml:AbstractFeatureType">
                    <xs:sequence>
                        <xs:element ref="hma:maskMembers"/>
                    </xs:sequence>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
        <xs:element name="maskMembers" type="hma:MaskMembersPropertyType"/>
        <xs:complexType name="MaskMembersPropertyType">
            <xs:sequence>
                <xs:element ref="hma:MaskFeature" minOccurs="0" maxOccurs="unbounded"/>
            </xs:sequence>
        </xs:complexType>
        <xs:element name="MaskFeature" type="hma:MaskFeatureType" substitutionGroup="gml:_Feature">
            <xs:annotation>
                <xs:documentation>Mask member : . Mandates the following optional gml properties inherited from gml:_Feature :
- gml:id attribute
- gml:name
- gml:boundedBy

Note : the upcoming gml:identifier will replace hma:identifier in GML 3.2</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:complexType name="MaskFeatureType">
            <xs:complexContent>
                <xs:extension base="gml:AbstractFeatureType">
                    <xs:sequence>
                        <xs:element name="maskType" type="hma:CodeWithAuthorityType">
                            <xs:annotation>
                                <xs:documentation>Mask type. Value list can be retrieved with
codeSpace</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element ref="gml:multiExtentOf">
                            <xs:annotation>
                                <xs:documentation>Mask member extent. Expected structure is
gml:Polygon/gml:exterior/gml:LinearRing/gml:posList with 0 to n gml:Polygon/gml:interior/gml:LinearRing/gml:posList elements
representing the holes.</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                    </xs:sequence>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
        <!-- ========================================================================== -->
        <!--   Specific information object :  -->
        <!--                 + should be used to add specific information to a generic EarthObservation -->
        <!--                   description. -->
        <!--                 + inheritance mechanism (thematic/specific) is prefered to the use of this object -->
        <!-- ========================================================================== -->
        <xs:element name="SpecificInformation" type="hma:SpecificInformationType"/>
        <xs:complexType name="SpecificInformationArrayPropertyType">
            <xs:sequence>
                <xs:element ref="hma:SpecificInformation" maxOccurs="unbounded"/>
            </xs:sequence>
        </xs:complexType>
        <xs:complexType name="SpecificInformationType">
            <xs:sequence>
                <xs:element name="localAttribute" type="xs:string">
```

```
                        <xs:annotation>
                            <xs:documentation>Container for ad-hoc metadata that does not merit a mission specific schema or
extension, the localAttribute describes the name of the attribute</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                    <xs:element name="localValue" type="xs:string">
                        <xs:annotation>
                            <xs:documentation>Container for ad-hoc metadata that does not merit a mission specific schema or
extension, the localAttribute describes the value of the attribute</xs:documentation>
                        </xs:annotation>
                    </xs:element>
                </xs:sequence>
            </xs:complexType>
            <!-- ========================================================================== -->
            <!--   Miscellaneous properties  -->
            <!-- ========================================================================== -->
            <xs:element name="identifier">
                <xs:annotation>
                    <xs:documentation>Identifier for metadata item, includes ground segment codespace to guarantee uniqueness
within HMA :
urn:HMA:GS:CollectionId:ProductId</xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                    <xs:restriction base="xs:string"/>
                </xs:simpleType>
            </xs:element>
            <xs:element name="doi">
                <xs:annotation>
                    <xs:documentation>Digital Object Identifier identifying the product</xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                    <xs:restriction base="xs:string"/>
                </xs:simpleType>
            </xs:element>
            <xs:element name="parentIdentifier">
                <xs:annotation>
                    <xs:documentation>Collection identifier</xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                    <xs:restriction base="xs:string"/>
                </xs:simpleType>
            </xs:element>
            <xs:element name="status">
                <xs:annotation>
                    <xs:documentation>Refers to product status. PHR : always "ACQUIRED"</xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="ACQUIRED"/>
                        <xs:enumeration value="ARCHIVED"/>
                        <xs:enumeration value="PLANNED"/>
                        <xs:enumeration value="POTENTIAL"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="acquisitionType">
                <xs:annotation>
                    <xs:documentation>Used to distinguish at a high level the appropriateness of the acquisition for "general" use,
whether the product is a nominal acquisition, special calibration product or other. Values:
    - NOMINAL
    - CALIBRATION
    - OTHER

More specific information (i.e. platform and sensor specific values) are expressed within the imageSubType tag.</xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="NOMINAL"/>
                        <xs:enumeration value="CALIBRATION"/>
                        <xs:enumeration value="OTHER"/>
                    </xs:restriction>
```

```
            </xs:simpleType>
        </xs:element>
        <xs:element name="acquisitionSubType" type="gml:CodeListType">
            <xs:annotation>
                <xs:documentation>The mission specific type definition should refer to mission/ground segment dedicated
codeSpace.
PHR values are :
"CALIBRATION - UNNORMALIZED"
"CALIBRATION - DARKNESS SEQUENCE"
"CALIBRATION - ASTRAL"
"CALIBRATION - AMETHIST"
"CALIBRATION - REFOCUSING SEQUENCE"
"MTSR MODE"
"DAS FILE"
"SPECIFIC-1"
"SPECIFIC-2"
"SPECIFIC-3"
"SPECIFIC-4"
    </xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="productType" type="xs:string">
            <xs:annotation>
                <xs:documentation>Describes product type in case that mixed types are available within a single collection. This is
ground segment specific definition</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="imageQualityDegradation" type="gml:MeasureType">
            <xs:annotation>
                <xs:documentation>Must be expressed in percents. EOLI N/A (attTypes/attName ?)</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="imageQualityDegradationQuotationMode">
            <xs:annotation>
                <xs:documentation>Indicator to know how the quality quotation has been calculated.</xs:documentation>
            </xs:annotation>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:pattern value="AUTOMATIC"/>
                    <xs:pattern value="MANUAL"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:element>
        <xs:element name="composedOf" type="hma:EarthObservationPropertyType"/>
        <xs:element name="subsetOf" type="hma:EarthObservationPropertyType"/>
        <xs:element name="linkedWith" type="hma:EarthObservationPropertyType"/>
        <!-- ========================================================================== -->
        <!--   Miscellaneous types  -->
        <!-- ========================================================================== -->
        <xs:complexType name="CodeWithAuthorityType">
            <xs:annotation>
                <xs:documentation>From GML 3.2 draft</xs:documentation>
            </xs:annotation>
            <xs:simpleContent>
                <xs:extension base="xs:string">
                    <xs:attribute name="codeSpace" type="xs:anyURI" use="required"/>
                </xs:extension>
            </xs:simpleContent>
        </xs:complexType>
</xs:schema>
```

D.2 Application schema for Thematic Optical EO Products

The following schema document, called *ohr.xsd*, contains elements to describe Thematic Optical EO Products using GML 3.1.1

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2007 sp1 (http://www.altova.com) by jrom (C.N.E.S.) -->
<!-- edited with XMLSPY v2004 rel. 2 U (http://www.xmlspy.com) by jrom (CNES) -->
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml" xmlns:hma="http://earth.esa.int/hma" xmlns:ohr="http://earth.esa.int/ohr"
targetNamespace="http://earth.esa.int/ohr" elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0">
	<xs:import namespace="http://www.opengis.net/gml" schemaLocation="../../gml/3.1.1/base/gmlSubset.xsd"/>
	<xs:import namespace="http://earth.esa.int/hma" schemaLocation="./hma.xsd"/>
	<!-- ========================================================================== -->
	<!--  Optical EarthObservation :  -->
	<!--		+ Inherits from hma:AbstractObservation -->
	<!-- ========================================================================== -->
	<xs:element name="EarthObservation" type="ohr:EarthObservationType" substitutionGroup="hma:EarthObservation">
		<xs:annotation>
			<xs:documentation>HMA root element for Optical Earth Observation Product description</xs:documentation>
		</xs:annotation>
	</xs:element>
	<xs:complexType name="EarthObservationType">
		<xs:complexContent>
			<xs:extension base="hma:EarthObservationType">
				<xs:sequence/>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
	<!-- ========================================================================== -->
	<!-- EarthObservationResult Feature : -->
	<!--		+ this feature extends hma:EarthObservationResult -->
	<!--		+ should be found within EarthObservation "result" property -->
	<!-- ========================================================================== -->
	<xs:element name="EarthObservationResult" type="ohr:EarthObservationResultType"
substitutionGroup="hma:EarthObservationResult"/>
	<xs:complexType name="EarthObservationResultType">
		<xs:complexContent>
			<xs:extension base="hma:EarthObservationResultType">
				<xs:sequence>
					<xs:element name="cloudCoverPercentage" type="gml:MeasureType" minOccurs="0">
						<xs:annotation>
							<xs:documentation>Must be expressed in percents</xs:documentation>
						</xs:annotation>
					</xs:element>
					<xs:element name="cloudCoverPercentageAssessmentConfidence" type="gml:MeasureType"
minOccurs="0">
						<xs:annotation>
							<xs:documentation>Cloud cover assessment confidence. Expressed in
percents.</xs:documentation>
						</xs:annotation>
					</xs:element>
					<xs:element name="cloudCoverPercentageQuotationMode" minOccurs="0">
						<xs:annotation>
							<xs:documentation>Indicator to know how the cloud cover percentage has been
calculated</xs:documentation>
						</xs:annotation>
						<xs:simpleType>
							<xs:restriction base="xs:string">
								<xs:enumeration value="AUTOMATIC"/>
								<xs:enumeration value="MANUAL"/>
							</xs:restriction>
						</xs:simpleType>
					</xs:element>
					<xs:element name="snowCoverPercentage" type="gml:MeasureType" minOccurs="0">
						<xs:annotation>
							<xs:documentation>Must be expressed in percents</xs:documentation>
						</xs:annotation>
					</xs:element>
```

```
                        <xs:element name="snowCoverPercentageAssessmentConfidence" type="gml:MeasureType"
minOccurs="0">
                            <xs:annotation>
                                <xs:documentation>Snow cover assessment confidence. Expressed in
percents.</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element name="snowCoverPercentageQuotationMode" minOccurs="0">
                            <xs:annotation>
                                <xs:documentation>Indicator to know how the snow cover percentage has been
calculated</xs:documentation>
                            </xs:annotation>
                            <xs:simpleType>
                                <xs:restriction base="xs:string">
                                    <xs:enumeration value="AUTOMATIC"/>
                                    <xs:enumeration value="MANUAL"/>
                                </xs:restriction>
                            </xs:simpleType>
                        </xs:element>
                    </xs:sequence>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
        <!-- ========================================================================== -->
        <!--  Acquisition  : -->
        <!--          + this feature extends hma:Acquisition -->
        <!-- ========================================================================== -->
        <xs:element name="Acquisition" type="ohr:AcquisitionType" substitutionGroup="hma:Acquisition"/>
        <xs:complexType name="AcquisitionType">
            <xs:complexContent>
                <xs:extension base="hma:AcquisitionType">
                    <xs:sequence>
                        <xs:element name="illuminationAzimuthAngle" type="gml:AngleType" minOccurs="0">
                            <xs:annotation>
                                <xs:documentation>Solar Azimuth angle given in degrees. EOLI : illAziAng
(F)</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                        <xs:element name="illuminationElevationAngle" type="gml:AngleType" minOccurs="0">
                            <xs:annotation>
                                <xs:documentation>Solar Elevation angle given in degrees. EOLI : illElevAng
(F)</xs:documentation>
                            </xs:annotation>
                        </xs:element>
                    </xs:sequence>
                </xs:extension>
            </xs:complexContent>
        </xs:complexType>
</xs:schema>
```

D.3 Application schema for Thematic Radar EO Products

The following schema document, called *sar.xsd*, contains elements to describe Thematic Radar EO Products using GML 3.1.1

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSPY v2004 rel. 2 U (http://www.xmlspy.com) by jrom (CNES) -->
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml" xmlns:hma="http://earth.esa.int/hma" xmlns:sar="http://earth.esa.int/sar"
targetNamespace="http://earth.esa.int/sar" elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0 ">
	<xs:import namespace="http://www.opengis.net/gml" schemaLocation="../../gml/3.1.1/base/gmlSubset.xsd"/>
	<xs:import namespace="http://earth.esa.int/hma" schemaLocation="./hma.xsd"/>
	<!-- ========================================================================== -->
	<!--   SAR EarthObservation :  -->
	<!--            + Inherits from hma:AbstractObservation -->
	<!-- ========================================================================== -->
	<xs:element name="EarthObservation" type="sar:EarthObservationType" substitutionGroup="hma:EarthObservation">
		<xs:annotation>
			<xs:documentation>HMA root element for SAR Earth Observation Product description.Namespace for SAR
products EarthObservationProduct. This is a first minimum set suggested by DLR. The configuration of EOWEB User Services for
TerraSAR-X is ongoing as well as the definition of Feature applicable to catalogue services. Sources: DLR TerraSAR-X PGS SAR
L1B Archive Product Specification, SAR Raw Exchange Product Specification</xs:documentation>
		</xs:annotation>
	</xs:element>
	<xs:complexType name="EarthObservationType">
		<xs:complexContent>
			<xs:extension base="hma:EarthObservationType">
				<xs:sequence/>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
	<!-- ========================================================================== -->
	<!--  Acquisition  : -->
	<!--            + this feature extends hma:Acquisition -->
	<!-- ========================================================================== -->
	<xs:element name="Acquisition" type="sar:AcquisitionType" substitutionGroup="hma:Acquisition"/>
	<xs:complexType name="AcquisitionType">
		<xs:complexContent>
			<xs:extension base="hma:AcquisitionType">
				<xs:sequence>
					<xs:element ref="sar:polarisationMode" minOccurs="0"/>
					<xs:element ref="sar:polarisationChannels" minOccurs="0"/>
					<xs:element ref="sar:antennaLookDirection" minOccurs="0"/>
					<xs:element ref="sar:minimumIncidenceAngle" minOccurs="0"/>
					<xs:element ref="sar:maximumIncidenceAngle" minOccurs="0"/>
					<xs:element ref="sar:dopplerFrequency" minOccurs="0"/>
					<xs:element ref="sar:swathId" minOccurs="0"/>
				</xs:sequence>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
	<!-- ========================================================================== -->
	<!--   Miscellaneous properties  -->
	<!-- ========================================================================== -->
	<xs:element name="polarisationMode" type="sar:PolarisationModePropertyType">
		<xs:annotation>
			<xs:documentation>single S, dual D, twin T, quad Q, UNDEFINED</xs:documentation>
		</xs:annotation>
	</xs:element>
	<xs:element name="polarisationChannels" type="sar:PolarisationChannelsPropertyType">
		<xs:annotation>
			<xs:documentation>Polarisation channel transmit/receive configuration: horizontal, vertical.</xs:documentation>
		</xs:annotation>
	</xs:element>
	<xs:element name="antennaLookDirection">
		<xs:annotation>
			<xs:documentation>Polarisation channel transmit/receive configuration: horizontal, vertical.</xs:documentation>
		</xs:annotation>
```

```
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="LEFT"/>
                    <xs:enumeration value="RIGHT"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:element>
        <xs:element name="minimumIncidenceAngle" type="gml:AngleType">
            <xs:annotation>
                <xs:documentation>Minimum Incidence angle.</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="maximumIncidenceAngle" type="gml:AngleType">
            <xs:annotation>
                <xs:documentation>Maximum Incidence angle.</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="dopplerFrequency" type="gml:MeasureType">
            <xs:annotation>
                <xs:documentation>Doppler Frequency of acquisition.</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="swathId" type="xs:string"/>
        <!-- ========================================================================== -->
        <!--   Miscellaneous types  -->
        <!-- ========================================================================== -->
        <xs:simpleType name="PolarisationChannelsPropertyType">
            <xs:restriction base="xs:string">
                <xs:enumeration value="HH"/>
                <xs:enumeration value="HV"/>
                <xs:enumeration value="VH"/>
                <xs:enumeration value="VV"/>
                <xs:enumeration value="HH, VV"/>
                <xs:enumeration value="HH, VH"/>
                <xs:enumeration value="HH, HV"/>
                <xs:enumeration value="VH, VV"/>
                <xs:enumeration value="VH, HV"/>
                <xs:enumeration value="VV, HV"/>
                <xs:enumeration value="HH, VV, HV, VH"/>
                <xs:enumeration value="UNDEFINED"/>
            </xs:restriction>
        </xs:simpleType>
        <xs:simpleType name="PolarisationModePropertyType">
            <xs:restriction base="xs:string">
                <xs:enumeration value="D"/>
                <xs:enumeration value="Q"/>
                <xs:enumeration value="S"/>
                <xs:enumeration value="T"/>
                <xs:enumeration value="UNDEFINED"/>
            </xs:restriction>
        </xs:simpleType>
        <xs:element name="acquiredBy" type="sar:SensorPropertyType"/>
        <xs:complexType name="SensorPropertyType">
            <xs:sequence>
                <xs:element ref="sar:Sensor"/>
            </xs:sequence>
        </xs:complexType>
        <xs:element name="Sensor" type="sar:SensorType"/>
        <xs:complexType name="SensorType">
            <xs:sequence>
                <xs:element name="swathIdentifier" type="gml:CodeListType">
                    <xs:annotation>
                        <xs:documentation>Swath identifier (e.g. Envisat ASAR has 7 distinct swaths (I1,I2,I3...I7) that
correspond to precise incidence angles for the sensor). Value list can be retrieved with codeSpace.</xs:documentation>
                    </xs:annotation>
                </xs:element>
            </xs:sequence>
        </xs:complexType>
</xs:schema>
```


D.4 Application schema for Specific Pleiades EO Products

The following schema document, called *atm.xsd*, contains elements to describe Thematic Atmospheric EO Products using GML 3.1.1

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSPY v2004 rel. 2 U (http://www.xmlspy.com) by jrom (CNES) -->
<xs:schema xmlns:atm="http://earth.esa.int/atm" xmlns:hma="http://earth.esa.int/hma" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xs="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://earth.esa.int/atm" elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0">
	<xs:import namespace="http://www.opengis.net/gml" schemaLocation="../../gml/3.1.1/base/gmlSubset.xsd"/>
	<xs:import namespace="http://earth.esa.int/hma" schemaLocation="./hma.xsd"/>
	<!-- ========================================================================== -->
	<!--  Atmospheric EarthObservation :  -->
	<!--		+ Inherits from hma:AbstractObservation -->
	<!-- ========================================================================== -->
	<xs:element name="EarthObservation" type="atm:EarthObservationType" substitutionGroup="hma:EarthObservation">
		<xs:annotation>
			<xs:documentation>Namespace for Atmospheric products EarthObservationProduct.</xs:documentation>
		</xs:annotation>
	</xs:element>
	<xs:complexType name="EarthObservationType">
		<xs:complexContent>
			<xs:extension base="hma:EarthObservationType">
				<xs:sequence/>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
	<!-- ========================================================================== -->
	<!--  EarthObservationResult Feature : -->
	<!--		+ this feature extends hma:EarthObservationResult -->
	<!--		+ should be found within EarthObservation "result" property -->
	<!-- ========================================================================== -->
	<xs:element name="EarthObservationResult" type="atm:EarthObservationResultType"
substitutionGroup="hma:EarthObservationResult"/>
	<xs:complexType name="EarthObservationResultType">
		<xs:complexContent>
			<xs:extension base="hma:EarthObservationResultType">
				<xs:sequence>
					<xs:element ref="atm:dataLayers" minOccurs="0"/>
				</xs:sequence>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
	<!-- ========================================================================== -->
	<!--  Datalayers  -->
	<!-- ========================================================================== -->
	<xs:element name="dataLayers" type="atm:DataLayerPropertyType"/>
	<xs:complexType name="DataLayerPropertyType">
		<xs:sequence>
			<xs:element ref="atm:DataLayer" maxOccurs="unbounded"/>
		</xs:sequence>
	</xs:complexType>
	<xs:element name="DataLayer" type="atm:DataLayerType"/>
	<xs:complexType name="DataLayerType">
		<xs:sequence>
			<xs:element name="specy" type="xs:string" minOccurs="0">
				<xs:annotation>
					<xs:documentation>Specy contained in data layer</xs:documentation>
				</xs:annotation>
			</xs:element>
			<xs:element name="unit" type="xs:string" minOccurs="0">
				<xs:annotation>
					<xs:documentation>Unit of specy in data layer</xs:documentation>
				</xs:annotation>
			</xs:element>
			<xs:element name="highestLocation" type="gml:MeasureType" minOccurs="0">
				<xs:annotation>
```

```
                        <xs:documentation>Top height of datalayer. Should be expressed in meters.</xs:documentation>
                    </xs:annotation>
                </xs:element>
                <xs:element name="lowestLocation" type="gml:MeasureType" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>Bottom height of datalayer. Should be expressed in meters.</xs:documentation>
                    </xs:annotation>
                </xs:element>
                <xs:element name="algorithmName" type="xs:string" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>Name of algorithm used to compute datalayer</xs:documentation>
                    </xs:annotation>
                </xs:element>
                <xs:element name="algorithmVersion" type="xs:string" minOccurs="0">
                    <xs:annotation>
                        <xs:documentation>Version of algorithm used to compute datalayer</xs:documentation>
                    </xs:annotation>
                </xs:element>
            </xs:sequence>
        </xs:complexType>
</xs:schema>
```

D.5 Application schema for Specific Pleiades EO Products

The following schema document, called *phr.xsd*, contains elements to describe Specific Pleiades HR EO Products using GML 3.1.1

TBD

Annex D
(normative)

Reference schematron rules for EO Products GML application schemas

D.1 Schematron rules for hma

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="schematron_skeleton_for_hma.xsl"?>
<schema xmlns="http://www.ascc.net/xml/schematron" xmlns:phr="http://hma.cnes.fr/phr"
xmlns:gml="http://www.opengis.net/gml" xmlns:hma="http://earth.esa.int/hma"
xmlns:ohr="http://earth.esa.int/ohr">
    <title>Technical document schema</title>
    <key name="author-e-mails" match="author" use="@e-mail"/>

    <!-- ================================================================ -->
    <!--  gml:metaDataProperty :  -->
    <!--      + expected contents is hma:EarthObservationMetadata  -->
    <!-- ================================================================ -->
    <!--
     ! if root is 'hma:EarthObservation' , content is always as expected in the hma level (i.e no extension is
possible)
     ! Since  'ohr:EarthObservation' does not extend metadataProperty, expected content is the same as
with hma
     ! Note : should be the same for other thematic schemas (To be discussed)
     !-->
    <pattern id="metaDataProperty_strict" name="metaDataProperty_strict">
        <rule
context="(hma:EarthObservation/gml:metaDataProperty)|(ohr:EarthObservation/gml:metaDataProperty)">
            <assert test="hma:EarthObservationMetaData">gml:metaDataProperty : expected content is
hma:EarthObservationMetadata for a hma:EarthObservation or a ohr:EarthObservation</assert>
        </rule>
    </pattern>
    <!--
     ! if root explicitaly refers to  'hma:EarthObservation' or 'ohr:EarthObservation', content can be as in the
preceding rule or can be an
     ! extension of hma:EarthObservationMetadata
     !-->
    <pattern id="metaDataProperty_extended" name="metaDataProperty_extended">
        <rule context="*[@hma:type = 'hma:EarthObservation' or @hma:type =
'ohr:EarthObservation']/gml:metaDataProperty">
            <assert test="hma:EarthObservationMetaData|*[@hma:type=
'hma:EarthObservationMetaData']">gml:metaDataProperty : expected content is
hma:EarthObservationMetadata or an extension (with appropriate attribute hma:type)</assert>
        </rule>
    </pattern>
    <!-- ================================================================ -->
    <!--  gml:using :  -->
    <!--      + expected contents is hma:EarthObservationEquipment. -->
    <!--     INCOMPLETE  -->
    <!-- ================================================================ -->
    <pattern id="using" name="using">
        <rule context="gml:using">
            <assert test="hma:EarthObservationEquipment">gml:using : expected contents is
hma:EarthObservationEquipment</assert>
        </rule>
    </pattern>
```

```
    <!-- ================================================================= -->
    <!--  gml:resultOf :  -->
    <!--      + expected contents is hma:EarthObservationResult. -->
    <!-- ================================================================= -->
    <!--
     !
     !-->
    <pattern id="resultOf_strict" name="resultOf_strict">
        <rule context="hma:EarthObservation/gml:resultOf">
            <assert test="hma:EarthObservationResult">gml:resultOf : expected content is
hma:EarthObservationResult for a hma:EarthObservation</assert>
        </rule>
    </pattern>
    <pattern id="resultOf_strict" name="resultOf_strict">
        <rule context="ohr:EarthObservation/gml:resultOf">
            <assert test="ohr:EarthObservationResult">gml:resultOf : expected content is
ohr:EarthObservationResult for a ohr:EarthObservation</assert>
        </rule>
    </pattern>
    <!--
     !
     !-->
    <pattern id="resultOf_extended" name="resultOf_extended">
        <rule context="*[@hma:type = 'hma:EarthObservation']/gml:resultOf">
            <assert test="hma:EarthObservationResult|*[@hma:type=
'hma:EarthObservationResult']">gml:resultOf : expected content is hma:EarthObservationResult or an
extension (with appropriate attribute hma:type)</assert>
        </rule>
    </pattern>
    <pattern id="resultOf_extended" name="resultOf_extended">
        <rule context="*[@hma:type = 'ohr:EarthObservation']/gml:resultOf">
            <assert test="ohr:EarthObservationResult|*[@hma:type=
'ohr:EarthObservationResult']">gml:resultOf : expected content is ohr:EarthObservationResult or an
extension (with appropriate attribute hma:type)</assert>
        </rule>
    </pattern>
    <!-- ================================================================= -->
    <!--  gml:target :  -->
    <!--      + expected contents is hma:Footprint. -->
    <!-- ================================================================= -->
    <pattern id="target" name="target">
        <rule context="gml:target">
            <assert test="hma:Footprint">gml:target : expected contents is hma:Footprint</assert>
        </rule>
    </pattern>
    <!-- ================================================================= -->
    <!--  gml:validTime :  -->
    <!--      + expected contents is gml:TimePeriod/gml:beginPosition.   -->
    <!--                             gml:TimePeriod/gml:endPosition.   -->
    <!-- ================================================================= -->
    <pattern id="validTime_beginPosition" name="validTime_beginPosition">
        <rule context="gml:validTime">
            <assert test="gml:TimePeriod/gml:beginPosition">gml:validTime : expected contents is
gml:TimePeriod/gml:beginPostition</assert>
        </rule>
    </pattern>
    <pattern id="validTime_endPosition" name="validTime_endPosition">
        <rule context="gml:validTime">
            <assert test="gml:TimePeriod/gml:endPosition">gml:validTime : expected contents is
gml:TimePeriod/gml:endPostition</assert>
        </rule>
    </pattern>
    <!-- ================================================================= -->
```

```
    <!--  Footprint gml:multiExtentOf :  -->
    <!--       + expected contents is
gml:MultiSurface/gml:surfaceMembers/gml:Polygon/gml:exterior/gml:LinearRing/gml:posList. -->
    <!-- ================================================================= -->
    <pattern id="footprint_extentOf" name="footprint_extentOf">
        <rule context="gml:multiExtentOf">
            <assert
test="gml:MultiSurface/gml:surfaceMembers/gml:Polygon/gml:exterior/gml:LinearRing/gml:posList">gml:mult
iExtentOf : expected contents is
gml:MultiSurface/gml:surfaceMembers/gml:Polygon/gml:exterior/gml:LinearRing/gml:posList</assert>
        </rule>
    </pattern>
    <!-- ================================================================= -->
    <!--  Footprint gml:centerOf :  -->
    <!--       + expected contents is gml:Point/gml:pos. -->
    <!-- ================================================================= -->
    <pattern id="footprint_centerOf" name="footprint_centerOf">
        <rule context="gml:centerOf">
            <assert test="gml:Point/gml:pos">gml:centerOf : expected contents is
gml:Point/gml:pos</assert>
        </rule>
    </pattern>
</schema>
```

Annex E
(normative)

GML Subset for EO Products GML application schemas

E.1 GML subset schema

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:sch="http://www.ascc.net/xml/schematron"
xmlns:gml="http://www.opengis.net/gml" xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" targetNamespace="http://www.opengis.net/gml"
elementFormDefault="qualified" version="3.1.1">
	<annotation>
		<documentation>GML Subset schema for
gml:metaDataProperty,gml:Polygon,gml:Point,gml:LineString,gml:LinearRing,gml:exterior,gml:interior,gml:surfaceProperty,gml:mul
tiSurfacePropertyType,gml:_Feature,gml:featureMember,gml:CodeListType,gml:AngleType,gml:MeasureListType,gml:centerOf,gml
:extentOf,gml:_MetaData,gml:Observation,gml:validTime,gml:beginPosition,gml:endPosition,gml:TimePeriod,gml:multiExtentOf,g
ml:_FeatureCollection, written by gmlSubset.xslt.
</documentation>
	</annotation>
	<import namespace="http://www.w3.org/1999/xlink" schemaLocation="../../../xlink/1.0.0/xlinks.xsd"/>
	<!-- ========================================================= -->
	<element name="metaDataProperty" type="gml:MetaDataPropertyType">
		<annotation>
			<documentation>Contains or refers to a metadata package that contains metadata properties.</documentation>
		</annotation>
	</element>
	<!-- ========================================================= -->
	<complexType name="MetaDataPropertyType">
		<annotation>
			<documentation>Base type for complex metadata property types.</documentation>
		</annotation>
		<sequence minOccurs="0">
			<any processContents="lax"/>
			<!-- <element ref="gml:_MetaData"/> -->
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
		<attribute name="about" type="anyURI" use="optional"/>
	</complexType>
	<!-- ========================================================= -->
	<attributeGroup name="AssociationAttributeGroup">
		<annotation>
			<documentation>Attribute group used to enable property elements to refer to their value remotely. It contains the
simple link components from xlinks.xsd, with all members optional, and the remoteSchema attribute, which is also optional.  These
attributes can be attached to any element, thus allowing it to act as a pointer. The 'remoteSchema' attribute allows an element  that
carries link attributes to indicate that the element is declared  in a remote schema rather than by the schema that constrains the current
document instance.</documentation>
		</annotation>
		<attributeGroup ref="xlink:simpleLink"/>
		<attribute ref="gml:remoteSchema" use="optional"/>
	</attributeGroup>
	<!-- ========================================================= -->
	<attribute name="remoteSchema" type="anyURI">
		<annotation>
			<documentation>Reference to an XML Schema fragment that specifies the content model of the propertys value.
This is in conformance with the XML Schema Section 4.14 Referencing Schemas from Elsewhere.</documentation>
		</annotation>
	</attribute>
	<!-- ========================================================= -->
	<element name="Polygon" type="gml:PolygonType" substitutionGroup="gml:_Surface"/>
	<!-- ========================================================= -->
	<complexType name="PolygonType">
		<annotation>
```

```
                <documentation>A Polygon is a special surface that is defined by a single surface patch. The boundary of this patch
is coplanar and the polygon uses planar interpolation in its interior. It is backwards compatible with the Polygon of GML 2,
GM_Polygon of ISO 19107 is implemented by PolygonPatch.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractSurfaceType">
                    <sequence>
                        <element ref="gml:exterior" minOccurs="0"/>
                        <element ref="gml:interior" minOccurs="0" maxOccurs="unbounded"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="AbstractSurfaceType">
            <annotation>
                <documentation>An abstraction of a surface to support the different levels of complexity. A surface is always a
continuous region of a plane.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometricPrimitiveType"/>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="AbstractGeometricPrimitiveType" abstract="true">
            <annotation>
                <documentation>This is the abstract root type of the geometric primitives. A geometric primitive is a geometric
object that is not
                decomposed further into other primitives in the system. All primitives are oriented in the direction implied by the
sequence of their
                coordinate tuples.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometryType"/>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="AbstractGeometryType" abstract="true">
            <annotation>
                <documentation>All geometry elements are derived directly or indirectly from this abstract supertype. A geometry
element may
                have an identifying attribute ("gml:id"), a name (attribute "name") and a description (attribute "description"). It may
be associated
                with a spatial reference system (attribute "srsName"). The following rules shall be adhered: - Every geometry type
shall derive
                from this abstract type. - Every geometry element (i.e. an element of a geometry type) shall be directly or indirectly
in the
                substitution group of _Geometry.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGMLType">
                    <attribute name="gid" type="string" use="optional">
                        <annotation>
                            <documentation>This attribute is included for backward compatibility with GML 2 and is
deprecated with GML 3.
                            This identifer is superceded by "gml:id" inherited from AbstractGMLType. The attribute "gid"
should not be used
                            anymore and may be deleted in future versions of GML without further notice.</documentation>
                        </annotation>
                    </attribute>
                    <attributeGroup ref="gml:SRSReferenceGroup"/>
                </extension>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="AbstractGMLType" abstract="true">
            <annotation>
                <documentation>All complexContent GML elements are directly or indirectly derived from this abstract supertype
        to establish a hierarchy of GML types that may be distinguished from other XML types by their ancestry.
        Elements in this hierarchy may have an ID and are thus referenceable.</documentation>
            </annotation>
```

```
            <sequence>
                <group ref="gml:StandardObjectProperties"/>
            </sequence>
            <attribute ref="gml:id" use="optional"/>
        </complexType>
        <!-- ====================================================== -->
        <group name="StandardObjectProperties">
            <annotation>
                <documentation>This content model group makes it easier to construct types that
    derive from AbstractGMLType and its descendents "by restriction".
    A reference to the group saves having to enumerate the standard object properties.</documentation>
            </annotation>
            <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>
        </group>
        <!-- ====================================================== -->
        <element name="description" type="gml:StringOrRefType">
            <annotation>
                <documentation>Contains a simple text description of the object, or refers to an external
description.</documentation>
            </annotation>
        </element>
        <!-- ====================================================== -->
        <complexType name="StringOrRefType">
            <annotation>
                <documentation>This type is available wherever there is a need for a "text" type property. It is of string type, so the
text can be included inline, but the value can also be referenced remotely via xlinks from the AssociationAttributeGroup. If the remote
reference is present, then the value obtained by traversing the link should be used, and the string content of the element can be used for
an annotation.</documentation>
            </annotation>
            <simpleContent>
                <extension base="string">
                    <attributeGroup ref="gml:AssociationAttributeGroup"/>
                </extension>
            </simpleContent>
        </complexType>
        <!-- ====================================================== -->
        <!-- ====================================================== -->
        <element name="name" type="gml:CodeType">
            <annotation>
                <documentation>Label for the object, normally a descriptive name. An object may have several names, typically
assigned by different authorities.  The authority for a name is indicated by the value of its (optional) codeSpace attribute.  The name
may or may not be unique, as determined by the rules of the organization responsible for the codeSpace.</documentation>
            </annotation>
        </element>
        <!-- ====================================================== -->
        <complexType name="CodeType">
            <annotation>
                <documentation>Name or code with an (optional) authority.  Text token.
    If the codeSpace attribute is present, then its value should identify a dictionary, thesaurus
    or authority for the term, such as the organisation who assigned the value,
    or the dictionary from which it is taken.
    A text string with an optional codeSpace attribute. </documentation>
            </annotation>
            <simpleContent>
                <extension base="string">
                    <attribute name="codeSpace" type="anyURI" use="optional"/>
                </extension>
            </simpleContent>
        </complexType>
        <!-- ====================================================== -->
        <attribute name="id" type="ID">
```

```
            <annotation>
                <documentation>Database handle for the object.  It is of XML type ID, so is constrained to be unique in the XML
document within which it occurs.  An external identifier for the object in the form of a URI may be constructed using standard XML
and XPointer methods.  This is done by concatenating the URI for the document, a fragment separator, and the value of the id
attribute.</documentation>
            </annotation>
        </attribute>
        <!-- ========================================================== -->
        <attributeGroup name="SRSReferenceGroup">
            <annotation>
                <documentation>Optional reference to the CRS used by this geometry, with optional additional information to
simplify use when
                a more complete definition of the CRS is not needed.</documentation>
            </annotation>
            <attribute name="srsName" type="anyURI" use="optional">
                <annotation>
                    <documentation>In general this reference points to a CRS instance of gml:CoordinateReferenceSystemType
                    (see coordinateReferenceSystems.xsd). For well known references it is not required that the CRS description
exists at the
                    location the URI points to. If no srsName attribute is given, the CRS must be specified as part of the larger
context this
                    geometry element is part of, e.g. a geometric element like point, curve, etc. It is expected that this attribute
will be specified
                    at the direct position level only in rare cases.</documentation>
                </annotation>
            </attribute>
            <attribute name="srsDimension" type="positiveInteger" use="optional">
                <annotation>
                    <documentation>The "srsDimension" is the length of coordinate sequence (the number of entries in the list).
This dimension is
                    specified by the coordinate reference system. When the srsName attribute is omitted, this attribute shall be
omitted.</documentation>
                </annotation>
            </attribute>
            <attributeGroup ref="gml:SRSInformationGroup"/>
        </attributeGroup>
        <!-- ========================================================== -->
        <attributeGroup name="SRSInformationGroup">
            <annotation>
                <documentation>Optional additional and redundant information for a CRS to simplify use when a more complete
definition of the
                CRS is not needed. This information shall be the same as included in the more complete definition of the CRS,
referenced by the
                srsName attribute. When the srsName attribute is included, either both or neither of the axisLabels and uomLabels
attributes
                shall be included. When the srsName attribute is omitted, both of these attributes shall be
omitted.</documentation>
            </annotation>
            <attribute name="axisLabels" type="gml:NCNameList" use="optional">
                <annotation>
                    <documentation>Ordered list of labels for all the axes of this CRS. The gml:axisAbbrev value should be used
for these axis
                    labels, after spaces and forbiddden characters are removed. When the srsName attribute is included, this
attribute is optional.
                    When the srsName attribute is omitted, this attribute shall also be omitted.</documentation>
                </annotation>
            </attribute>
            <attribute name="uomLabels" type="gml:NCNameList" use="optional">
                <annotation>
                    <documentation>Ordered list of unit of measure (uom) labels for all the axes of this CRS. The value of the
string in the
                    gml:catalogSymbol should be used for this uom labels, after spaces and forbiddden characters are removed.
When the
                    axisLabels attribute is included, this attribute shall also be included. When the axisLabels attribute is omitted,
this attribute
                    shall also be omitted.</documentation>
                </annotation>
            </attribute>
        </attributeGroup>
        <!-- ========================================================== -->
        <simpleType name="NCNameList">
```

```
            <annotation>
                <documentation>A set of values, representing a list of token with the lexical value space of NCName. The tokens
are seperated by whitespace.</documentation>
            </annotation>
            <list itemType="NCName"/>
        </simpleType>
        <!-- ========================================================== -->
        <!-- ========================================================== -->
        <element name="exterior" type="gml:AbstractRingPropertyType">
            <annotation>
                <documentation>A boundary of a surface consists of a number of rings. In the normal 2D case, one of these rings is
distinguished as being the exterior boundary. In a general manifold this is not always possible, in which case all boundaries shall be
listed as interior boundaries, and the exterior will be empty.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="AbstractRingPropertyType">
            <annotation>
                <documentation>Encapsulates a ring to represent the surface boundary property of a surface.</documentation>
            </annotation>
            <sequence>
                <element ref="gml:_Ring"/>
            </sequence>
        </complexType>
        <!-- ========================================================== -->
        <element name="_Ring" type="gml:AbstractRingType" abstract="true" substitutionGroup="gml:_Geometry">
            <annotation>
                <documentation>The "_Ring" element is the abstract head of the substituition group for all closed boundaries of a
surface patch.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="AbstractRingType" abstract="true">
            <annotation>
                <documentation>An abstraction of a ring to support surface boundaries of different complexity.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometryType"/>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <element name="_Geometry" type="gml:AbstractGeometryType" abstract="true" substitutionGroup="gml:_GML">
            <annotation>
                <documentation>The "_Geometry" element is the abstract head of the substituition group for all geometry elements
of GML 3. This
                includes pre-defined and user-defined geometry elements. Any geometry element must be a direct or indirect
extension/restriction
                of AbstractGeometryType and must be directly or indirectly in the substitution group of
"_Geometry".</documentation>
                <appinfo>
                    <sch:pattern name="Check SRS tags">
                        <sch:rule context="gml:_Geometry">
                            <sch:extends rule="CRSLabels"/>
                        </sch:rule>
                    </sch:pattern>
                </appinfo>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="_GML" type="gml:AbstractGMLType" abstract="true" substitutionGroup="gml:_Object">
            <annotation>
                <documentation>Global element which acts as the head of a substitution group that may include any element which
is a GML feature, object, geometry or complex value</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="_Object" abstract="true">
            <annotation>
                <documentation>This abstract element is the head of a substitutionGroup hierararchy which may contain either
simpleContent or complexContent elements.  It is used to assert the model position of "class" elements declared in other GML
schemas.</documentation>
```

```
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="interior" type="gml:AbstractRingPropertyType">
            <annotation>
                <documentation>A boundary of a surface consists of a number of rings. The "interior" rings seperate the surface /
surface patch from the area enclosed by the rings.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="_Surface" type="gml:AbstractSurfaceType" abstract="true" substitutionGroup="gml:_GeometricPrimitive">
            <annotation>
                <documentation>The "_Surface" element is the abstract head of the substituition group for all (continuous) surface
elements.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="_GeometricPrimitive" type="gml:AbstractGeometricPrimitiveType" abstract="true"
substitutionGroup="gml:_Geometry">
            <annotation>
                <documentation>The "_GeometricPrimitive" element is the abstract head of the substituition group for all (pre- and
user-defined)
                geometric primitives.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="Point" type="gml:PointType" substitutionGroup="gml:_GeometricPrimitive"/>
        <!-- ========================================================== -->
        <complexType name="PointType">
            <annotation>
                <documentation>A Point is defined by a single coordinate tuple.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometricPrimitiveType">
                    <sequence>
                        <choice>
                            <annotation>
                                <documentation>GML supports two different ways to specify the direct poisiton of a
point. 1. The "pos" element is of type
                                DirectPositionType.</documentation>
                            </annotation>
                            <element ref="gml:pos"/>
                            <element ref="gml:coordinates">
                                <annotation>
                                    <documentation>Deprecated with GML version 3.1.0 for coordinates with ordinate
values that are numbers. Use "pos"
                                    instead. The "coordinates" element shall only be used for coordinates with ordinates
that require a string
                                    representation, e.g. DMS representations.</documentation>
                                </annotation>
                            </element>
                            <element ref="gml:coord">
                                <annotation>
                                    <documentation>Deprecated with GML version 3.0. Use "pos" instead. The "coord"
element is included for
                                    backwards compatibility with GML 2.</documentation>
                                </annotation>
                            </element>
                        </choice>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <element name="pos" type="gml:DirectPositionType">
            <annotation>
                <appinfo>
                    <sch:pattern name="Check SRS tags">
                        <sch:rule context="gml:pos">
                            <sch:extends rule="CRSLabels"/>
                        </sch:rule>
```

```
                    </sch:pattern>
                </appinfo>
            </annotation>
        </element>
        <!-- ================================================== -->
        <complexType name="DirectPositionType">
            <annotation>
                <documentation>DirectPosition instances hold the coordinates for a position within some coordinate reference
system (CRS). Since
                DirectPositions, as data types, will often be included in larger objects (such as geometry elements) that have
references to CRS, the
                "srsName" attribute will in general be missing, if this particular DirectPosition is included in a larger element with
such a reference to a
                CRS. In this case, the CRS is implicitly assumed to take on the value of the containing object's
CRS.</documentation>
            </annotation>
            <simpleContent>
                <extension base="gml:doubleList">
                    <attributeGroup ref="gml:SRSReferenceGroup"/>
                </extension>
            </simpleContent>
        </complexType>
        <!-- ================================================== -->
        <simpleType name="doubleList">
            <annotation>
                <documentation>XML List based on XML Schema double type.  An element of this type contains a space-
separated list of double values</documentation>
            </annotation>
            <list itemType="double"/>
        </simpleType>
        <!-- ================================================== -->
        <!-- ================================================== -->
        <element name="coordinates" type="gml:CoordinatesType">
            <annotation>
                <documentation>Deprecated with GML version 3.1.0.</documentation>
            </annotation>
        </element>
        <!-- ================================================== -->
        <complexType name="CoordinatesType">
            <annotation>
                <documentation>Tables or arrays of tuples.
      May be used for text-encoding of values from a table.
      Actually just a string, but allows the user to indicate which characters are used as separators.
      The value of the 'cs' attribute is the separator for coordinate values,
      and the value of the 'ts' attribute gives the tuple separator (a single space by default);
      the default values may be changed to reflect local usage.
      Defaults to CSV within a tuple, space between tuples.
      However, any string content will be schema-valid.  </documentation>
            </annotation>
            <simpleContent>
                <extension base="string">
                    <attribute name="decimal" type="string" default="."/>
                    <attribute name="cs" type="string" default=","/>
                    <attribute name="ts" type="string" default=" "/>
                </extension>
            </simpleContent>
        </complexType>
        <!-- ================================================== -->
        <element name="coord" type="gml:CoordType">
            <annotation>
                <documentation>Deprecated with GML 3.0 and included for backwards compatibility with GML 2. Use the "pos"
element instead.</documentation>
            </annotation>
        </element>
        <!-- ================================================== -->
        <complexType name="CoordType">
            <annotation>
                <documentation>Represents a coordinate tuple in one, two, or three dimensions. Deprecated with GML 3.0 and
replaced by
                DirectPositionType.</documentation>
            </annotation>
```

```
            <sequence>
                <element name="X" type="decimal"/>
                <element name="Y" type="decimal" minOccurs="0"/>
                <element name="Z" type="decimal" minOccurs="0"/>
            </sequence>
        </complexType>
        <!-- ========================================================== -->
        <element name="LineString" type="gml:LineStringType" substitutionGroup="gml:_Curve"/>
        <!-- ========================================================== -->
        <complexType name="LineStringType">
            <annotation>
                <documentation>A LineString is a special curve that consists of a single segment with linear interpolation. It is defined by two or more coordinate
                tuples, with linear interpolation between them. It is backwards compatible with the LineString of GML 2, GM_LineString of ISO 19107 is
                implemented by LineStringSegment.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractCurveType">
                    <sequence>
                        <choice>
                            <annotation>
                                <documentation>GML supports two different ways to specify the control points of a line string. 1. A sequence of "pos"
                                (DirectPositionType) or "pointProperty" (PointPropertyType) elements. "pos" elements are control points that are only part
                                of this curve, "pointProperty" elements contain a point that may be referenced from other geometry elements or reference
                                another point defined outside of this curve (reuse of existing points). 2. The "posList" element allows for a compact way to
                                specifiy the coordinates of the control points, if all control points are in the same coordinate reference systems and belong
                                to this curve only. The number of direct positions in the list must be at least two.</documentation>
                            </annotation>
                            <choice minOccurs="2" maxOccurs="unbounded">
                                <element ref="gml:pos"/>
                                <element ref="gml:pointProperty"/>
                                <element ref="gml:pointRep">
                                    <annotation>
                                        <documentation>Deprecated with GML version 3.1.0. Use "pointProperty" instead. Included for backwards compatibility
                                        with GML 3.0.0.</documentation>
                                    </annotation>
                                </element>
                                <element ref="gml:coord">
                                    <annotation>
                                        <documentation>Deprecated with GML version 3.0. Use "pos" instead. The "coord" element is included for backwards
                                        compatibility with GML 2.</documentation>
                                    </annotation>
                                </element>
                            </choice>
                            <element ref="gml:posList"/>
                            <element ref="gml:coordinates">
                                <annotation>
                                    <documentation>Deprecated with GML version 3.1.0. Use "posList" instead.</documentation>
                                </annotation>
                            </element>
                        </choice>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="AbstractCurveType" abstract="true">
            <annotation>
                <documentation>An abstraction of a curve to support the different levels of complexity. The curve can always be viewed as a geometric
                primitive, i.e. is continuous.</documentation>
```

```
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometricPrimitiveType"/>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <element name="pointProperty" type="gml:PointPropertyType">
            <annotation>
                <appinfo>
                    <sch:pattern name="Check either href or content not both">
                        <sch:rule context="gml:pointProperty">
                            <sch:extends rule="hrefOrContent"/>
                        </sch:rule>
                    </sch:pattern>
                </appinfo>
                <documentation>This property element either references a point via the XLink-attributes or contains the point
element. pointProperty
                is the predefined property which can be used by GML Application Schemas whenever a GML Feature has a
property with a value that
                is substitutable for Point.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="PointPropertyType">
            <annotation>
                <documentation>A property that has a point as its value domain can either be an appropriate geometry element
encapsulated in an
                element of this type or an XLink reference to a remote geometry element (where remote includes geometry
elements located
                elsewhere in the same document). Either the reference or the contained element must be given, but neither both nor
none.</documentation>
            </annotation>
            <sequence minOccurs="0">
                <element ref="gml:Point"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup">
                <annotation>
                    <documentation>This attribute group includes the XLink attributes (see xlinks.xsd). XLink is used in GML
to reference remote
                    resources (including those elsewhere in the same document). A simple link element can be constructed by
including a specific
                    set of XLink attributes. The XML Linking Language (XLink) is currently a Proposed Recommendation of the
World Wide Web Consortium.
                    XLink allows elements to be inserted into XML documents so as to create sophisticated links between
resources; such links can be
                    used to reference remote properties. A simple link element can be used to implement pointer functionality,
and this functionality has
                    been built into various GML 3 elements by including the gml:AssociationAttributeGroup.</documentation>
                </annotation>
            </attributeGroup>
        </complexType>
        <!-- ========================================================== -->
        <element name="pointRep" type="gml:PointPropertyType">
            <annotation>
                <documentation>Deprecated with GML version 3.1.0. Use "pointProperty" instead. Included for backwards
compatibility with GML 3.0.0.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="posList" type="gml:DirectPositionListType">
            <annotation>
                <appinfo>
                    <sch:pattern name="Check SRS tags">
                        <sch:rule context="gml:posList">
                            <sch:extends rule="CRSLabels"/>
                        </sch:rule>
                    </sch:pattern>
                </appinfo>
                <appinfo>
                    <sch:pattern name="Check Dimension">
                        <sch:rule context="gml:posList">
```

```
                                <sch:extends rule="Count"/>
                            </sch:rule>
                        </sch:pattern>
                    </appinfo>
                </annotation>
            </element>
            <!-- ========================================================== -->
            <complexType name="DirectPositionListType">
                <annotation>
                    <documentation>DirectPositionList instances hold the coordinates for a sequence of direct positions within the same coordinate
                    reference system (CRS).</documentation>
                </annotation>
                <simpleContent>
                    <extension base="gml:doubleList">
                        <attributeGroup ref="gml:SRSReferenceGroup"/>
                        <attribute name="count" type="positiveInteger" use="optional">
                            <annotation>
                                <documentation>"count" allows to specify the number of direct positions in the list. If the attribute count is present then
                                the attribute srsDimension shall be present, too.</documentation>
                            </annotation>
                        </attribute>
                    </extension>
                </simpleContent>
            </complexType>
            <!-- ========================================================== -->
            <element name="_Curve" type="gml:AbstractCurveType" abstract="true" substitutionGroup="gml:_GeometricPrimitive">
                <annotation>
                    <documentation>The "_Curve" element is the abstract head of the substituition group for all (continuous) curve elements.</documentation>
                </annotation>
            </element>
            <!-- ========================================================== -->
            <element name="LinearRing" type="gml:LinearRingType" substitutionGroup="gml:_Ring"/>
            <!-- ========================================================== -->
            <complexType name="LinearRingType">
                <annotation>
                    <documentation>A LinearRing is defined by four or more coordinate tuples, with linear interpolation between them; the first and last coordinates must be coincident.</documentation>
                </annotation>
                <complexContent>
                    <extension base="gml:AbstractRingType">
                        <sequence>
                            <choice>
                                <annotation>
                                    <documentation>GML supports two different ways to specify the control points of a linear ring.
1. A sequence of "pos" (DirectPositionType) or "pointProperty" (PointPropertyType) elements. "pos" elements are control points that are only part of this ring, "pointProperty" elements contain a point that may be referenced from other geometry elements or reference another point defined outside of this ring (reuse of existing points).
2. The "posList" element allows for a compact way to specifiy the coordinates of the control points, if all control points are in the same coordinate reference systems and belong to this ring only. The number of direct positions in the list must be at least four.</documentation>
                                </annotation>
                                <choice minOccurs="4" maxOccurs="unbounded">
                                    <element ref="gml:pos"/>
                                    <element ref="gml:pointProperty"/>
                                    <element ref="gml:pointRep">
                                        <annotation>
                                            <documentation>Deprecated with GML version 3.1.0. Use "pointProperty" instead. Included for backwards compatibility with GML 3.0.0.</documentation>
                                        </annotation>
                                    </element>
                                </choice>
                                <element ref="gml:posList"/>
                                <element ref="gml:coordinates">
                                    <annotation>
                                        <documentation>Deprecated with GML version 3.1.0. Use "posList" instead.</documentation>
                                    </annotation>
```

```
                                    </element>
                                    <element ref="gml:coord" minOccurs="4" maxOccurs="unbounded">
                                        <annotation>
                                            <documentation>Deprecated with GML version 3.0 and included for backwards
compatibility with GML 2. Use "pos" elements instead.</documentation>
                                        </annotation>
                                    </element>
                                </choice>
                            </sequence>
                        </extension>
                    </complexContent>
                </complexType>
                <!-- ========================================================== -->
                <element name="surfaceProperty" type="gml:SurfacePropertyType">
                    <annotation>
                        <appinfo>
                            <sch:pattern name="Check either href or content not both">
                                <sch:rule context="gml:surfaceProperty">
                                    <sch:extends rule="hrefOrContent"/>
                                </sch:rule>
                            </sch:pattern>
                        </appinfo>
                        <documentation>This property element either references a surface via the XLink-attributes or contains the surface
element. surfaceProperty is the predefined property which can be used by GML Application Schemas whenever a GML Feature has a
property with a value that is substitutable for _Surface.</documentation>
                    </annotation>
                </element>
                <!-- ========================================================== -->
                <complexType name="SurfacePropertyType">
                    <annotation>
                        <documentation>A property that has a surface as its value domain can either be an appropriate geometry element
encapsulated in an element of this type or an XLink reference to a remote geometry element (where remote includes geometry
elements located elsewhere in the same document). Either the reference or the contained element must be given, but neither both nor
none.</documentation>
                    </annotation>
                    <sequence minOccurs="0">
                        <element ref="gml:_Surface"/>
                    </sequence>
                    <attributeGroup ref="gml:AssociationAttributeGroup">
                        <annotation>
                            <documentation>This attribute group includes the XLink attributes (see xlinks.xsd). XLink is used in GML
to reference remote resources (including those elsewhere in the same document). A simple link element can be constructed by
including a specific set of XLink attributes. The XML Linking Language (XLink) is currently a Proposed Recommendation of the
World Wide Web Consortium. XLink allows elements to be inserted into XML documents so as to create sophisticated links between
resources; such links can be used to reference remote properties.
A simple link element can be used to implement pointer functionality, and this functionality has been built into various GML 3
elements by including the gml:AssociationAttributeGroup.</documentation>
                        </annotation>
                    </attributeGroup>
                </complexType>
                <!-- ========================================================== -->
                <!-- ========================================================== -->
                <element name="_Feature" type="gml:AbstractFeatureType" abstract="true" substitutionGroup="gml:_GML"/>
                <!-- ========================================================== -->
                <complexType name="AbstractFeatureType" abstract="true">
                    <annotation>
                        <documentation>An abstract feature provides a set of common properties, including id, metaDataProperty, name
and description inherited from AbstractGMLType, plus boundedBy.    A concrete feature type must derive from this type and specify
additional  properties in an application schema. A feature must possess an identifying attribute ('id' - 'fid' has been
deprecated).</documentation>
                    </annotation>
                    <complexContent>
                        <extension base="gml:AbstractGMLType">
                            <sequence>
                                <element ref="gml:boundedBy" minOccurs="0"/>
                                <element ref="gml:location" minOccurs="0">
                                    <annotation>
                                        <appinfo>deprecated</appinfo>
                                        <documentation>deprecated in GML version 3.1</documentation>
                                    </annotation>
                                </element>
```

```
                        <!-- additional properties must be specified in an application schema -->
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <element name="boundedBy" type="gml:BoundingShapeType"/>
        <!-- ========================================================== -->
        <complexType name="BoundingShapeType">
            <annotation>
                <documentation>Bounding shape.</documentation>
            </annotation>
            <sequence>
                <choice>
                    <element ref="gml:Envelope"/>
                    <element ref="gml:Null"/>
                </choice>
            </sequence>
        </complexType>
        <!-- ========================================================== -->
        <element name="Envelope" type="gml:EnvelopeType"/>
        <!-- ========================================================== -->
        <complexType name="EnvelopeType">
            <annotation>
                <documentation>Envelope defines an extent using a pair of positions defining opposite corners in arbitrary
dimensions. The first direct
                position is the "lower corner" (a coordinate position consisting of all the minimal ordinates for each dimension for
all points within the envelope),
                the second one the "upper corner" (a coordinate position consisting of all the maximal ordinates for each dimension
for all points within the
                envelope).</documentation>
            </annotation>
            <choice>
                <sequence>
                    <element name="lowerCorner" type="gml:DirectPositionType"/>
                    <element name="upperCorner" type="gml:DirectPositionType"/>
                </sequence>
                <element ref="gml:coord" minOccurs="2" maxOccurs="2">
                    <annotation>
                        <appinfo>deprecated</appinfo>
                        <documentation>deprecated with GML version 3.0</documentation>
                    </annotation>
                </element>
                <element ref="gml:pos" minOccurs="2" maxOccurs="2">
                    <annotation>
                        <appinfo>deprecated</appinfo>
                        <documentation>Deprecated with GML version 3.1. Use the explicit properties "lowerCorner" and
"upperCorner" instead.</documentation>
                    </annotation>
                </element>
                <element ref="gml:coordinates">
                    <annotation>
                        <documentation>Deprecated with GML version 3.1.0. Use the explicit properties "lowerCorner" and
"upperCorner" instead.</documentation>
                    </annotation>
                </element>
            </choice>
            <attributeGroup ref="gml:SRSReferenceGroup"/>
        </complexType>
        <!-- ========================================================== -->
        <element name="Null" type="gml:NullType"/>
        <!-- ========================================================== -->
        <simpleType name="NullType">
            <annotation>
                <documentation>Utility type for null elements.  The value may be selected from one of the enumerated tokens, or
may be a URI in which case this should identify a resource which describes the reason for the null. </documentation>
            </annotation>
            <union memberTypes="gml:NullEnumeration anyURI"/>
        </simpleType>
        <!-- ========================================================== -->
        <simpleType name="NullEnumeration">
```

```
            <annotation>
                <documentation> Some common reasons for a null value:

    innapplicable - the object does not have a value
    missing - The correct value is not readily available to the sender of this data.
                Furthermore, a correct value may not exist.
    template - the value will be available later
    unknown - The correct value is not known to, and not computable by, the sender of this data.
                However, a correct value probably exists.
    withheld - the value is not divulged

    other:reason - as indicated by "reason" string

    Specific communities may agree to assign more strict semantics when these terms are used in a particular context.
</documentation>
            </annotation>
            <union>
                <simpleType>
                    <restriction base="string">
                        <enumeration value="inapplicable"/>
                        <enumeration value="missing"/>
                        <enumeration value="template"/>
                        <enumeration value="unknown"/>
                        <enumeration value="withheld"/>
                    </restriction>
                </simpleType>
                <simpleType>
                    <restriction base="string">
                        <pattern value="other:\w{2,}"/>
                    </restriction>
                </simpleType>
            </union>
    </simpleType>
    <!-- ========================================================== -->
    <!-- ========================================================== -->
    <element name="location" type="gml:LocationPropertyType">
            <annotation>
                <documentation>Deprecated in GML 3.1.0</documentation>
            </annotation>
    </element>
    <!-- ========================================================== -->
    <complexType name="LocationPropertyType">
            <annotation>
                <documentation>Convenience property for generalised location.
A representative location for plotting or analysis.
Often augmented by one or more additional geometry properties with more specific semantics.</documentation>
                <documentation>Deprecated in GML 3.1.0</documentation>
            </annotation>
            <sequence minOccurs="0">
                <choice>
                    <element ref="gml:_Geometry"/>
                    <element ref="gml:LocationKeyWord"/>
                    <element ref="gml:LocationString"/>
                    <element ref="gml:Null"/>
                </choice>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
    </complexType>
    <!-- ========================================================== -->
    <element name="LocationKeyWord" type="gml:CodeType"/>
    <!-- ========================================================== -->
    <element name="LocationString" type="gml:StringOrRefType"/>
    <!-- ========================================================== -->
    <element name="featureMember" type="gml:FeaturePropertyType"/>
    <!-- ========================================================== -->
    <complexType name="FeaturePropertyType">
            <annotation>
                <documentation>Container for a feature - follow gml:AssociationType pattern.</documentation>
            </annotation>
            <sequence minOccurs="0">
                <element ref="gml:_Feature"/>
```

```
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
        </complexType>
        <!-- ================================================== -->
        <complexType name="CodeListType">
            <annotation>
                <documentation>List of values on a uniform nominal scale.  List of text tokens.
    In a list context a token should not include any spaces, so xsd:Name is used instead of xsd:string.
    If a codeSpace attribute is present, then its value is a reference to
    a Reference System for the value, a dictionary or code list.</documentation>
            </annotation>
            <simpleContent>
                <extension base="gml:NameList">
                    <attribute name="codeSpace" type="anyURI" use="optional"/>
                </extension>
            </simpleContent>
        </complexType>
        <!-- ================================================== -->
        <simpleType name="NameList">
            <annotation>
                <documentation>XML List based on XML Schema Name type.  An element of this type contains a space-separated
list of Name values</documentation>
            </annotation>
            <list itemType="Name"/>
        </simpleType>
        <!-- ================================================== -->
        <complexType name="AngleType">
            <annotation>
                <documentation>Value of an angle quantity recorded as a single number, with its units. Uses the MeasureType
with the restriction that the unit of measure referenced by uom must be suitable for an angle, such as degrees or
radians.</documentation>
            </annotation>
            <simpleContent>
                <restriction base="gml:MeasureType"/>
            </simpleContent>
        </complexType>
        <!-- ================================================== -->
        <complexType name="MeasureType">
            <annotation>
                <documentation>[MODIFIED from GML 3.2] gml:MeasureType supports recording an amount encoded as a value
of XML Schema double, together with a units of measure indicated by an attribute uom, short for “units Of measure”. The value of the
uom attribute identifies a reference system for the amount, usually a ratio or interval scale.</documentation>
            </annotation>
            <simpleContent>
                <extension base="double">
                    <attribute name="uom" type="gml:UomIdentifier" use="required"/>
                </extension>
            </simpleContent>
        </complexType>
        <simpleType name="UomIdentifier">
            <annotation>
                <documentation>The simple type gml:UomIdentifer defines the syntax and value space of the unit of measure
identifier.</documentation>
            </annotation>
            <union memberTypes="gml:UomSymbol gml:UomURI"/>
        </simpleType>
        <simpleType name="UomSymbol">
            <annotation>
                <documentation>This type specifies a character string of length at least one, and restricted such that it must not
contain any of the following characters: “:” (colon), “ “ (space), (newline), (carriage return), (tab). This allows values corresponding to
familiar abbreviations, such as “kg”, “m/s”, etc.
It is recommended that the symbol be an identifier for a unit of measure as specified in the “Unified Code of Units of Measure"
(UCUM) (http://aurora.regenstrief.org/UCUM). This provides a set of symbols and a grammar for constructing identifiers for units of
measure that are unique, and may be easily entered with a keyboard supporting the limited character set known as 7-bit ASCII. ISO
2955 formerly provided a specification with this scope, but was withdrawn in 2001. UCUM largely follows ISO 2955 with
modifications to remove ambiguities and other problems.</documentation>
            </annotation>
            <restriction base="string">
                <pattern value="[^: \n\r\t]+"/>
            </restriction>
        </simpleType>
```

```
        <simpleType name="UomURI">
            <annotation>
                <documentation>This type specifies a URI, restricted such that it must start with one of the following sequences:
“#”, “./”, “../”, or a string of characters followed by a “:”. These patterns ensure that the most common URI forms are supported,
including absolute and relative URIs and URIs that are simple fragment identifiers, but prohibits certain forms of relative URI that
could be mistaken for unit of measure symbol .
NOTE        It is possible to re-write such a relative URI to conform to the restriction (e.g. “./m/s”).
In an instance document, on elements of type gml:MeasureType the mandatory uom attribute shall carry a value corresponding to
either
-       a conventional unit of measure symbol,
-       a link to a definition of a unit of measure that does not have a conventional symbol, or when it is desired to indicate a precise or
variant definition.</documentation>
            </annotation>
            <restriction base="anyURI">
                <pattern value="([a-zA-Z][a-zA-Z0-9\-\+\.]*:|\.\./|\./|#).*"/>
            </restriction>
        </simpleType>
        <!-- ========================================================== -->
        <complexType name="MeasureListType">
            <annotation>
                <documentation>List of numbers with a uniform scale.
    The value of uom (Units Of Measure) attribute is a reference to
    a Reference System for the amount, either a ratio or position scale. </documentation>
            </annotation>
            <simpleContent>
                <extension base="gml:doubleList">
                    <attribute name="uom" type="anyURI" use="required"/>
                </extension>
            </simpleContent>
        </complexType>
        <!-- ========================================================== -->
        <element name="centerOf" type="gml:PointPropertyType"/>
        <!-- ========================================================== -->
        <element name="extentOf" type="gml:SurfacePropertyType"/>
        <!-- ========================================================== -->
        <element name="_MetaData" type="gml:AbstractMetaDataType" abstract="true" substitutionGroup="gml:_Object">
            <annotation>
                <documentation>Abstract element which acts as the head of a substitution group for packages of MetaData
properties.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="AbstractMetaDataType" abstract="true" mixed="true">
            <annotation>
                <documentation>An abstract base type for complex metadata types.</documentation>
            </annotation>
            <attribute ref="gml:id" use="optional"/>
        </complexType>
        <!-- ========================================================== -->
        <element name="Observation" type="gml:ObservationType" substitutionGroup="gml:_Feature"/>
        <!-- ========================================================== -->
        <complexType name="ObservationType">
            <complexContent>
                <extension base="gml:AbstractFeatureType">
                    <sequence>
                        <element ref="gml:validTime"/>
                        <element ref="gml:using" minOccurs="0"/>
                        <element ref="gml:target" minOccurs="0"/>
                        <element ref="gml:resultOf"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <element name="validTime" type="gml:TimePrimitivePropertyType"/>
        <!-- ========================================================== -->
        <complexType name="TimePrimitivePropertyType">
            <sequence minOccurs="0">
                <element ref="gml:_TimePrimitive"/>
            </sequence>
            <attributeGroup ref="gml:AssociationAttributeGroup"/>
```

```
	</complexType>
	<!-- ========================================================== -->
	<element name="_TimePrimitive" type="gml:AbstractTimePrimitiveType" abstract="true"
substitutionGroup="gml:_TimeObject">
		<annotation>
			<documentation xml:lang="en">This abstract element acts as the head of the substitution group for temporal
primitives.</documentation>
		</annotation>
	</element>
	<!-- ========================================================== -->
	<complexType name="AbstractTimePrimitiveType" abstract="true">
		<annotation>
			<documentation xml:lang="en">The abstract supertype for temporal primitives.</documentation>
		</annotation>
		<complexContent>
			<extension base="gml:AbstractTimeObjectType">
				<sequence>
					<element name="relatedTime" type="gml:RelatedTimeType" minOccurs="0"
maxOccurs="unbounded"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ========================================================== -->
	<complexType name="AbstractTimeObjectType" abstract="true">
		<annotation>
			<documentation xml:lang="en">The abstract supertype for temporal objects.</documentation>
		</annotation>
		<complexContent>
			<extension base="gml:AbstractGMLType"/>
		</complexContent>
	</complexType>
	<!-- ========================================================== -->
	<complexType name="RelatedTimeType">
		<complexContent>
			<extension base="gml:TimePrimitivePropertyType">
				<attribute name="relativePosition">
					<simpleType>
						<restriction base="string">
							<enumeration value="Before"/>
							<enumeration value="After"/>
							<enumeration value="Begins"/>
							<enumeration value="Ends"/>
							<enumeration value="During"/>
							<enumeration value="Equals"/>
							<enumeration value="Contains"/>
							<enumeration value="Overlaps"/>
							<enumeration value="Meets"/>
							<enumeration value="OverlappedBy"/>
							<enumeration value="MetBy"/>
							<enumeration value="BegunBy"/>
							<enumeration value="EndedBy"/>
						</restriction>
					</simpleType>
				</attribute>
			</extension>
		</complexContent>
	</complexType>
	<!-- ========================================================== -->
	<element name="_TimeObject" type="gml:AbstractTimeObjectType" abstract="true" substitutionGroup="gml:_GML">
		<annotation>
			<documentation xml:lang="en">This abstract element acts as the head of the substitution group for temporal
primitives and complexes.</documentation>
		</annotation>
	</element>
	<!-- ========================================================== -->
	<element name="using" type="gml:FeaturePropertyType">
		<annotation>
			<documentation>This element contains or points to a description of a sensor, instrument or procedure used for the
observation</documentation>
		</annotation>
```

```
	</element>
	<!-- ========================================================== -->
	<element name="target" type="gml:TargetPropertyType">
		<annotation>
			<documentation>This element contains or points to the specimen, region or station which is the object of the
observation</documentation>
		</annotation>
	</element>
	<!-- ========================================================== -->
	<complexType name="TargetPropertyType">
		<annotation>
			<documentation>Container for an object representing the target or subject of an observation.</documentation>
		</annotation>
		<sequence minOccurs="0">
			<choice>
				<element ref="gml:_Feature"/>
				<element ref="gml:_Geometry"/>
			</choice>
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
	</complexType>
	<!-- ========================================================== -->
	<element name="resultOf" type="gml:AssociationType">
		<annotation>
			<documentation>The result of the observation: an image, external object, etc</documentation>
		</annotation>
	</element>
	<!-- ========================================================== -->
	<complexType name="AssociationType">
		<annotation>
			<documentation>A pattern or base for derived types used to specify complex types corresponding to an
unspecified UML association - either composition or aggregation.  Restricts the cardinality of Objects contained in the association to a
maximum of one.  An instance of this type can contain an element representing an Object, or serve as a pointer to a remote Object.

Descendents of this type can be restricted in an application schema to
* allow only specified classes as valid participants in the aggregation
* allow only association by reference (i.e. empty the content model) or by value (i.e. remove the xlinks).

When used for association by reference, the value of the gml:remoteSchema attribute can be used to locate a schema fragment that
constrains the target instance.

In many cases it is desirable to impose the constraint prohibiting the occurence of both reference and value in the same instance, as
that would be ambiguous.  This is accomplished by adding a directive in the annotation element of the element declaration.  This
directive can be in the form of normative prose, or can use a Schematron pattern to automatically constrain co-occurrence - see the
declaration for _strictAssociation below.

If co-occurence is not prohibited, then both a link and content may be present.  If this occurs in an instance, then the rule for
interpretation is that the instance found by traversing the href provides the normative value of the property, and should be used when
possible.  The value(s) included as content may be used if the remote instance cannot be resolved.  This may be considered to be a
"cached" version of the value(s).</documentation>
		</annotation>
		<sequence minOccurs="0">
			<element ref="gml:_Object"/>
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
	</complexType>
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<element name="TimePeriod" type="gml:TimePeriodType" substitutionGroup="gml:_TimeGeometricPrimitive"/>
	<!-- ========================================================== -->
	<complexType name="TimePeriodType">
		<complexContent>
			<extension base="gml:AbstractTimeGeometricPrimitiveType">
				<sequence>
					<choice>
						<element name="beginPosition" type="gml:TimePositionType"/>
						<element name="begin" type="gml:TimeInstantPropertyType"/>
					</choice>
					<choice>
						<element name="endPosition" type="gml:TimePositionType"/>
```

```
                        <element name="end" type="gml:TimeInstantPropertyType"/>
                    </choice>
                    <group ref="gml:timeLength" minOccurs="0"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
    <!-- ========================================================== -->
    <complexType name="AbstractTimeGeometricPrimitiveType" abstract="true">
        <annotation>
            <documentation xml:lang="en">The abstract supertype for temporal geometric primitives.
A temporal geometry must be associated with a temporal reference system via URI.
The Gregorian calendar with UTC is the default reference system, following ISO
8601. Other reference systems in common use include the GPS calendar and the
Julian calendar.</documentation>
        </annotation>
        <complexContent>
            <extension base="gml:AbstractTimePrimitiveType">
                <attribute name="frame" type="anyURI" use="optional" default="#ISO-8601"/>
            </extension>
        </complexContent>
    </complexType>
    <!-- ========================================================== -->
    <complexType name="TimePositionType" final="#all">
        <annotation>
            <documentation xml:lang="en">Direct representation of a temporal position.
Indeterminate time values are also allowed, as described in ISO 19108. The indeterminatePosition
attribute can be used alone or it can qualify a specific value for temporal position (e.g. before
2002-12, after 1019624400).
For time values that identify position within a calendar, the calendarEraName attribute provides
the name of the calendar era to which the date is referenced (e.g. the Meiji era of the Japanese calendar).</documentation>
        </annotation>
        <simpleContent>
            <extension base="gml:TimePositionUnion">
                <attribute name="frame" type="anyURI" use="optional" default="#ISO-8601"/>
                <attribute name="calendarEraName" type="string" use="optional"/>
                <attribute name="indeterminatePosition" type="gml:TimeIndeterminateValueType" use="optional"/>
            </extension>
        </simpleContent>
    </complexType>
    <!-- ========================================================== -->
    <simpleType name="TimePositionUnion">
        <annotation>
            <documentation xml:lang="en">The ISO 19108:2002 hierarchy of subtypes for temporal position are collapsed
by defining a union of XML Schema simple types for indicating temporal position relative
to a specific reference system.

Dates and dateTime may be indicated with varying degrees of precision.
dateTime by itself does not allow right-truncation, except for fractions of seconds.
When used with non-Gregorian calendars based on years, months, days,
the same lexical representation should still be used, with leading zeros added if the
year value would otherwise have fewer than four digits.

An ordinal position may be referenced via URI identifying the definition of an ordinal era.

A time coordinate value is indicated as a decimal (e.g. UNIX time, GPS calendar).</documentation>
        </annotation>
        <union memberTypes="gml:CalDate time dateTime anyURI decimal"/>
    </simpleType>
    <!-- ========================================================== -->
    <simpleType name="CalDate">
        <annotation>
            <documentation xml:lang="en">Calendar dates may be indicated with varying degrees of precision,
using year, year-month, date.
When used with non-Gregorian calendars based on years, months, days,
the same lexical representation should still be used, with leading zeros added if the
year value would otherwise have fewer than four digits.
time is used for a position that recurs daily (see clause 5.4.4.2 of ISO 19108:2002).</documentation>
        </annotation>
        <union memberTypes="date gYearMonth gYear"/>
    </simpleType>
```

```
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<!-- ========================================================== -->
	<simpleType name="TimeIndeterminateValueType">
		<annotation>
			<documentation xml:lang="en">This enumerated data type specifies values for indeterminate
positions.</documentation>
		</annotation>
		<restriction base="string">
			<enumeration value="after"/>
			<enumeration value="before"/>
			<enumeration value="now"/>
			<enumeration value="unknown"/>
		</restriction>
	</simpleType>
	<!-- ========================================================== -->
	<complexType name="TimeInstantPropertyType">
		<sequence minOccurs="0">
			<element ref="gml:TimeInstant"/>
		</sequence>
		<attributeGroup ref="gml:AssociationAttributeGroup"/>
	</complexType>
	<!-- ========================================================== -->
	<element name="TimeInstant" type="gml:TimeInstantType" substitutionGroup="gml:_TimeGeometricPrimitive"/>
	<!-- ========================================================== -->
	<complexType name="TimeInstantType">
		<annotation>
			<documentation>Omit back-pointers begunBy, endedBy.</documentation>
		</annotation>
		<complexContent>
			<extension base="gml:AbstractTimeGeometricPrimitiveType">
				<sequence>
					<element ref="gml:timePosition"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ========================================================== -->
	<element name="timePosition" type="gml:TimePositionType">
		<annotation>
			<documentation>Direct representation of a temporal position</documentation>
		</annotation>
	</element>
	<!-- ========================================================== -->
	<element name="_TimeGeometricPrimitive" type="gml:AbstractTimeGeometricPrimitiveType" abstract="true"
substitutionGroup="gml:_TimePrimitive">
		<annotation>
			<documentation xml:lang="en">This abstract element acts as the head of the substitution group for temporal
geometric primitives.</documentation>
		</annotation>
	</element>
	<!-- ========================================================== -->
	<group name="timeLength">
		<annotation>
			<documentation>This model group is provided as an alternative to the abstract susbstitutionGroup head
_timeLength.
		ISO 19136 comment 411</documentation>
		</annotation>
		<choice>
			<element ref="gml:duration"/>
			<element ref="gml:timeInterval"/>
		</choice>
	</group>
	<!-- ========================================================== -->
	<element name="duration" type="duration">
		<annotation>
			<documentation xml:lang="en">This element is an instance of the primitive xsd:duration simple type to
```

```
enable use of the ISO 8601 syntax for temporal length (e.g. P5DT4H30M).
It is a valid subtype of TimeDurationType according to section 3.14.6,
rule 2.2.4 in XML Schema, Part 1.</documentation>
        </annotation>
    </element>
    <!-- ========================================================== -->
    <element name="timeInterval" type="gml:TimeIntervalLengthType">
        <annotation>
            <documentation>This element is a valid subtype of TimeDurationType
            according to section 3.14.6, rule 2.2.4 in XML Schema, Part 1.</documentation>
        </annotation>
    </element>
    <!-- ========================================================== -->
    <complexType name="TimeIntervalLengthType" final="#all">
        <annotation>
            <documentation xml:lang="en">This type extends the built-in xsd:decimal simple type to allow floating-point
values for temporal length. According to  the ISO 11404 model you have to use
positiveInteger together with appropriate values for radix and factor. The
resolution of the time interval is to one radix ^(-factor) of the specified
time unit (e.g. unit="second", radix="10", factor="3" specifies a resolution
of milliseconds). It is a subtype of TimeDurationType.</documentation>
        </annotation>
        <simpleContent>
            <extension base="decimal">
                <attribute name="unit" type="gml:TimeUnitType" use="required"/>
                <attribute name="radix" type="positiveInteger" use="optional"/>
                <attribute name="factor" type="integer" use="optional"/>
            </extension>
        </simpleContent>
    </complexType>
    <!-- ========================================================== -->
    <simpleType name="TimeUnitType">
        <annotation>
            <documentation xml:lang="en">Standard units for measuring time intervals (see ISO 31-1).</documentation>
        </annotation>
        <union>
            <simpleType>
                <restriction base="string">
                    <enumeration value="year"/>
                    <enumeration value="day"/>
                    <enumeration value="hour"/>
                    <enumeration value="minute"/>
                    <enumeration value="second"/>
                </restriction>
            </simpleType>
            <simpleType>
                <restriction base="string">
                    <pattern value="other:\w{2,}"/>
                </restriction>
            </simpleType>
        </union>
    </simpleType>
    <!-- ========================================================== -->
    <element name="multiExtentOf" type="gml:MultiSurfacePropertyType"/>
    <!-- ========================================================== -->
    <complexType name="MultiSurfacePropertyType">
        <annotation>
            <documentation>A property that has a collection of surfaces as its value domain can either be an appropriate
geometry element encapsulated in an element of this type or an XLink reference to a remote geometry element (where remote includes
geometry elements located elsewhere in the same document). Either the reference or the contained element must be given, but neither
both nor none.</documentation>
        </annotation>
        <sequence minOccurs="0">
            <element ref="gml:MultiSurface"/>
        </sequence>
        <attributeGroup ref="gml:AssociationAttributeGroup">
            <annotation>
                <documentation>This attribute group includes the XLink attributes (see xlinks.xsd). XLink is used in GML
to reference remote resources (including those elsewhere in the same document). A simple link element can be constructed by
including a specific set of XLink attributes. The XML Linking Language (XLink) is currently a Proposed Recommendation of the
```



```
World Wide Web Consortium. XLink allows elements to be inserted into XML documents so as to create sophisticated links between
resources; such links can be used to reference remote properties.
A simple link element can be used to implement pointer functionality, and this functionality has been built into various GML 3
elements by including the gml:AssociationAttributeGroup.</documentation>
                </annotation>
            </attributeGroup>
        </complexType>
        <!-- ========================================================== -->
        <element name="MultiSurface" type="gml:MultiSurfaceType" substitutionGroup="gml:_GeometricAggregate"/>
        <!-- ========================================================== -->
        <complexType name="MultiSurfaceType">
            <annotation>
                <documentation>A MultiSurface is defined by one or more Surfaces, referenced through surfaceMember
elements.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometricAggregateType">
                    <sequence>
                        <annotation>
                            <documentation>The members of the geometric aggregate can be specified either using the
"standard" property or the array property style. It is also valid to use both the "standard" and the array property style in the same
collection.
NOTE: Array properties cannot reference remote geometry elements.</documentation>
                        </annotation>
                        <element ref="gml:surfaceMember" minOccurs="0" maxOccurs="unbounded"/>
                        <element ref="gml:surfaceMembers" minOccurs="0"/>
                    </sequence>
                </extension>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <complexType name="AbstractGeometricAggregateType" abstract="true">
            <annotation>
                <documentation>This is the abstract root type of the geometric aggregates.</documentation>
            </annotation>
            <complexContent>
                <extension base="gml:AbstractGeometryType"/>
            </complexContent>
        </complexType>
        <!-- ========================================================== -->
        <element name="surfaceMember" type="gml:SurfacePropertyType">
            <annotation>
                <documentation>This property element either references a surface via the XLink-attributes or contains the surface
element. A surface element is any element which is substitutable for "_Surface".</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <element name="surfaceMembers" type="gml:SurfaceArrayPropertyType">
            <annotation>
                <documentation>This property element contains a list of surfaces. The order of the elements is significant and shall
be preserved when processing the array.</documentation>
            </annotation>
        </element>
        <!-- ========================================================== -->
        <complexType name="SurfaceArrayPropertyType">
            <annotation>
                <documentation>A container for an array of surfaces. The elements are always contained in the array property,
referencing geometry elements or arrays of geometry elements is not supported.</documentation>
            </annotation>
            <sequence>
                <element ref="gml:_Surface" minOccurs="0" maxOccurs="unbounded"/>
            </sequence>
        </complexType>
        <!-- ========================================================== -->
        <element name="_GeometricAggregate" type="gml:AbstractGeometricAggregateType" abstract="true"
substitutionGroup="gml:_Geometry">
            <annotation>
                <documentation>The "_GeometricAggregate" element is the abstract head of the substituition group for all
geometric aggremates.</documentation>
            </annotation>
        </element>
```

```
	<!-- ================================================== -->
	<element name="_FeatureCollection" type="gml:AbstractFeatureCollectionType" abstract="true"
substitutionGroup="gml:_Feature"/>
	<!-- ================================================== -->
	<complexType name="AbstractFeatureCollectionType" abstract="true">
		<annotation>
			<documentation>A feature collection contains zero or more features.</documentation>
		</annotation>
		<complexContent>
			<extension base="gml:AbstractFeatureType">
				<sequence>
					<element ref="gml:featureMember" minOccurs="0" maxOccurs="unbounded"/>
					<element ref="gml:featureMembers" minOccurs="0"/>
				</sequence>
			</extension>
		</complexContent>
	</complexType>
	<!-- ================================================== -->
	<element name="featureMembers" type="gml:FeatureArrayPropertyType"/>
	<!-- ================================================== -->
	<complexType name="FeatureArrayPropertyType">
		<annotation>
			<documentation>Container for features - follow gml:ArrayAssociationType pattern.</documentation>
		</annotation>
		<sequence>
			<element ref="gml:_Feature" minOccurs="0" maxOccurs="unbounded"/>
		</sequence>
	</complexType>
</schema>
```