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GML 3.1.1 Application schema for Earth Observation products

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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).

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v. Revision history

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19 September 2006	0.1.3	Jerome Gasperi	N/A	Update document regarding version 0.92 of the XML schema
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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 OGC shall not be held responsible for identifying any or all such patent rights.

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: **TBD**. 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 km² 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)

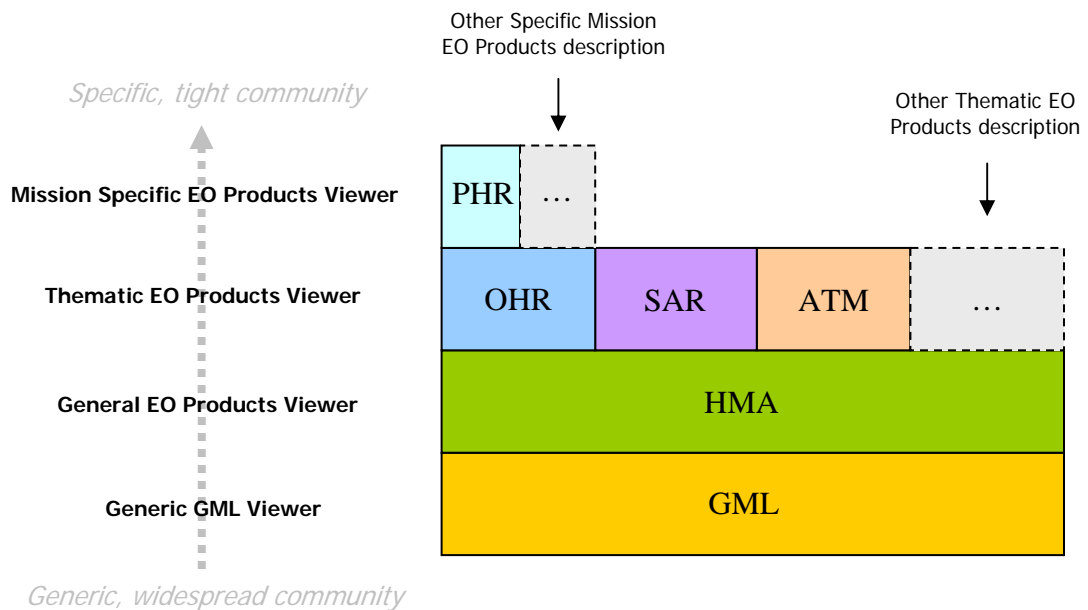


Figure 1 : A layered view of GML EO Products data..

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”.

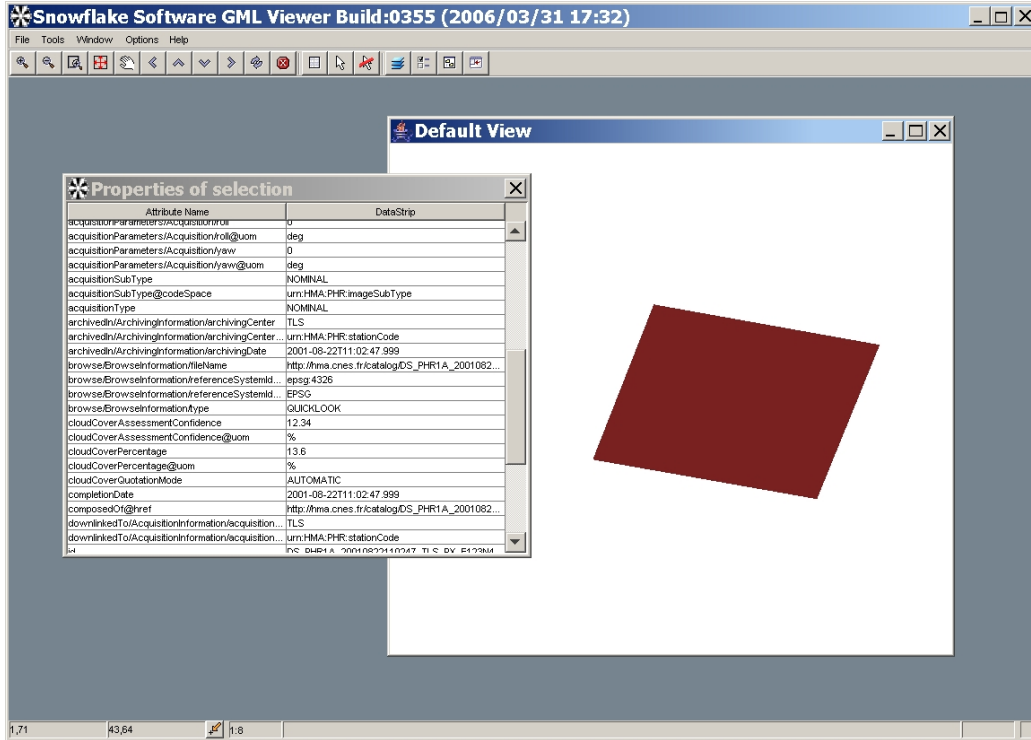


Figure 2 : A generic GML viewer understand the “gml” vocabulary and thus displays the product footprint (gml:extentOf property). With no semantic knowledge on the EO product schema, the reader is able to displays the related attributes in an xpath/value fashion

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

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 abbreviations.

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:illuminationAzimuthAngle>56,67</ohr:illuminationAzimuthAngle>
        </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 thematic 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 definition 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.

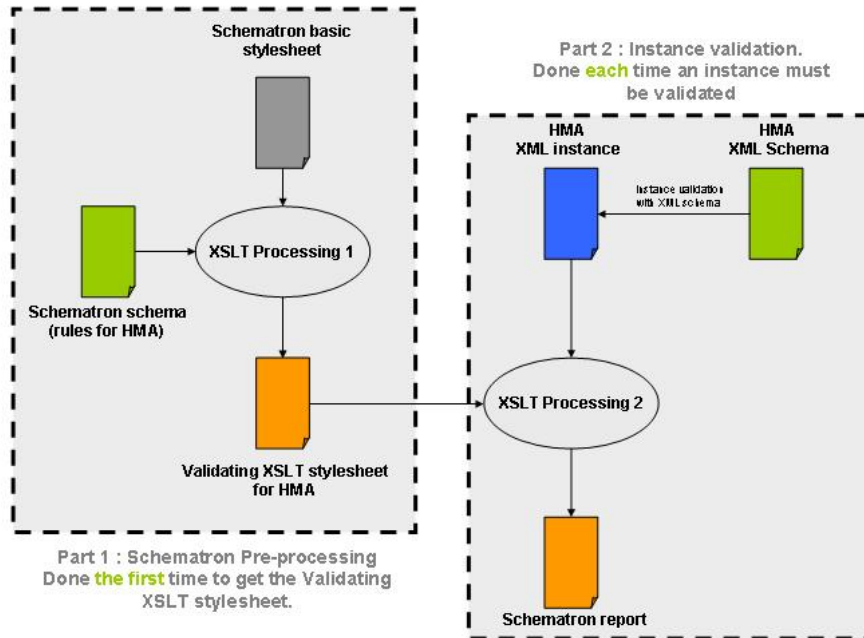


Figure 3 : schematron processing for Earth Observation products

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 syntactically and semantically by the HMA XML schema; second it is validated against the validating stylesheet. 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:extentOf* must contains a *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 explicitelty 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>
```

```

    </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="acrossTrackPointingAngle" 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:extentOf (expected structure : 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>
```

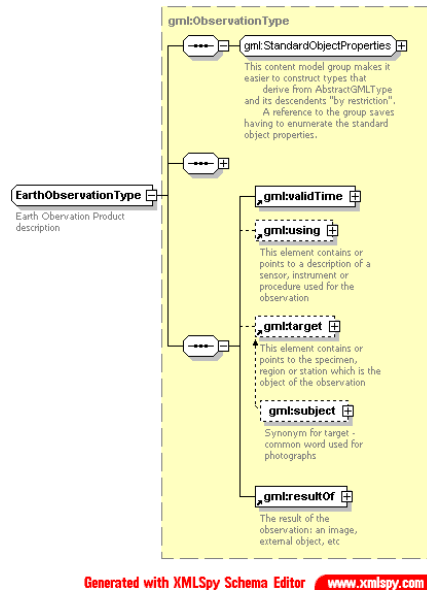


Figure 4: <hma:EarthObservationType> diagram

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/	Acquisition end date time dateTime in ISO 8601	MI_AcquisitionInformation/ MI_MissionIdentification/	no	1

gml:endPosition	format (CCYY-MM-DDThh:mm[:ss[.cc]]Z)	completionDate		
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).

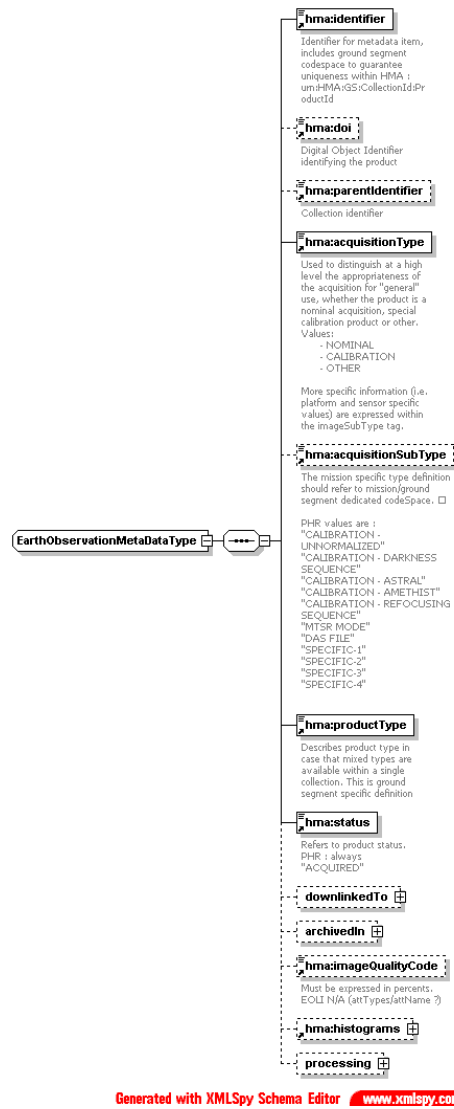


Figure 5 : <hma:EarthObservationMetadata> diagram

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	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 AcquisitionInf

GML Application Schema for EO Products

	codespace.			ormation 0..n)
downloadedTo/ 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 ArchivingInfor mation 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
imageQualityCode	Quality notation percentage (i.e. uom='%')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ imageQualityCode	yes (assuming ISO code is a percentage)	0..1
histograms/ Histogram/ bandId	Histogram 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	1
histograms/ Histogram/ stdDeviation	Histogram specific : standard deviation value		no	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 software 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).

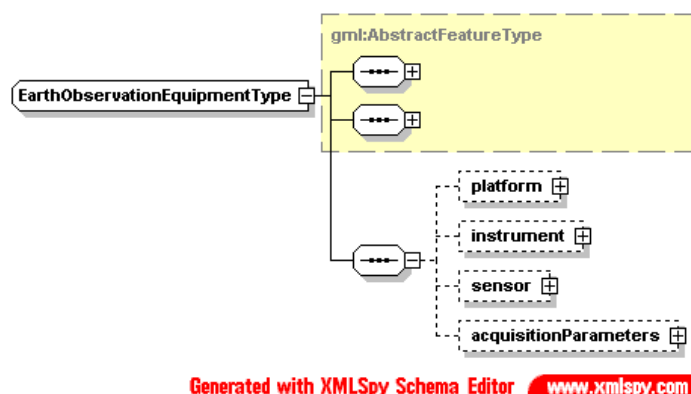


Figure 6 : <hma:EarthObservationEquipment> diagram

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/M I_PlatformIdentificatation/ shortName	yes	1
platform/ Platform/ serialIdentifier	Platform serial identifier (e.g. for PHR : 1A)	MD_DataIdentification/ MI_DataIdentification/ MI_AcquisitionInformation/M I_PlatformIdentificatation/ 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/ MI_PlatformIdentificatation/ MI_InstrumentIdentification/ shortName	yes	1
sensor/ Sensor/ sensorType	Sensor type. This field should contain an enumeration : - OPTICAL	MD_CoverageDescription/ MI_CoverageDescription/ MI_Sensor/	yes	0..1

	- RADAR - ALTIMETRIC - ATMOSPHERIC	sensorType		
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
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/ ascendingNodeDate	UTC date and time at ascending node of orbit		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/ acrossTrackPointingAngle	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/ alongTrackPointingAngle	Acquisition along the track incidence angle given in degrees (i.e.	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/	no (consistency in HMA	0..1

	uom='deg')	TBD	between two angle definitions)	
acquisitionParameters/ Acquisition/ pointingAngle	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).

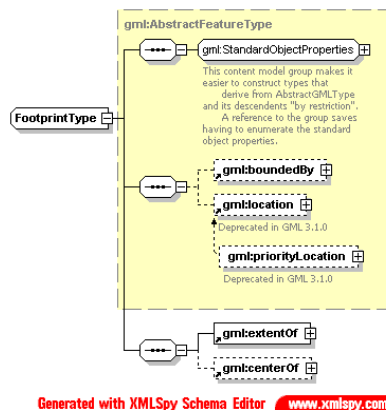


Figure 7 : <hma:Footprint> diagram

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

Field name	Field description	ISO 19115-2 definition	ISO mapping	Cardinality
extentOf	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)		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).

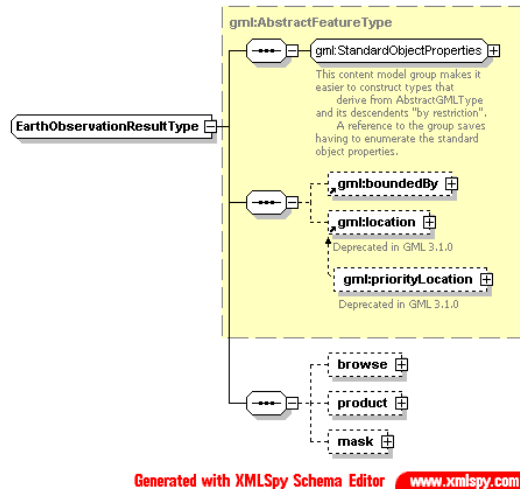


Figure 8 : <hma:EarthObservationResult> diagram

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 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_Identification/ MD_BrowseGraphic ?	no	1
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 MaskInformation on 0..n)
mask/ MaskInformation/ format	Mask format. Possible values are : RASTER or VECTOR		no	1 (with MaskInformation on 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		no	1 (with MaskInformation on 0..n)

	contains the OGC standard SERVICE=WMS			
--	---------------------------------------	--	--	--

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:cloudCoveragePercentage	Snow cover percentage (i.e. uom='%')	MD_ContentInformation/ MD_CoverageDescription/ MD_ImageDescription/ cloudCoveragePercentage	yes	0..1
ohr:EarthObservationResult/ ohr:cloudCoveragePercentage	Cloud cover percentage (i.e. uom='%')		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 Valid : 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. Valid: - 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/ sar:maximumIncidenceAngle	maximum incidence angle		no	1
hma:EarthObservationEquipment/ hma:acquisitionParameters/ sar:Acquisition/ sar:dopplerFrequency	Doppler Frequency of acquisition		no	1
hma:EarthObservationEquipment/ hma:acquisitionParameters/	TBD		no	0..1

sar:Acquisition/ sar:swathId				
---------------------------------	--	--	--	--

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/ atm:DataLayer/ atm:unit	Unit of specy in dataLayer		no	1
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

Due to the scope of our needs, i.e. Earth Observation, it should be discussed whether or not this Application schema should reference a GML subset instead of the complete GML definition.

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 **TBD**. 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/0.94/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:imageQualityCode uom="%">0</hma:imageQualityCode>
      <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:acrossTrackPointingAngle uom="deg">-14.0</hma:acrossTrackPointingAngle>
      <hma:alongTrackPointingAngle uom="deg">-13.9</hma:alongTrackPointingAngle>
      <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:extentOf>
      <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:extentOf>
    <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>
  </ohr:EarthObservationResult>
</gml:resultOf>

```

```
</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 targetNamespace="http://earth.esa.int/hma" xmlns:hma="http://earth.esa.int/hma"
xmlns:gml="http://www.opengis.net/gml" xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:om="http://www.opengis.net/om"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="0.94">
  <xs:import namespace="http://www.opengis.net/gml"
schemaLocation="../../gml/3.1.1/base/observation.xsd"/>
  <xs:import namespace="http://www.opengis.net/gml"
schemaLocation="../../gml/3.1.1/base/coverage.xsd"/>
  <xs:import namespace="http://www.opengis.net/gml"
schemaLocation="../../gml/3.1.1/base/feature.xsd"/>
  <xs:import namespace="http://www.opengis.net/gml"
schemaLocation="../../gml/3.1.1/base/measures.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 Observation 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:imageQualityCode" minOccurs="0"/>
        <xs:element ref="hma:histograms" minOccurs="0"/>
        <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="acrossTrackPointingAngle" 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="alongTrackPointingAngle" 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="pointingAngle" 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:sequence>
</xs:complexType>

```



```

    <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: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:extentOf">
            <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:sequence>
</xs:complexType>

```

```

</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>

```

```

    </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 software 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"/>
      <xs:element name="stdDeviation" type="xs:double"/>
    </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
  </xs:documentation>
  </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
  </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
  </xs:documentation>
  </xs:annotation>

```

```

    <xs:documentation>Mask member : . Mandates the following optional gml properties inherited
    from gml:_Feature :
    - gml:id attribute
    - gml:name
    - gml:boundedBy
  </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:complexType name="MaskFeatureType">
  <xs:complexContent>
    <xs:extension base="gml:AbstractFeatureType">
      <xs:sequence>

```

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
  </xs:documentation>
  </xs:annotation>

```

```

    <xs:documentation>Mask member : . Mandates the following optional gml properties inherited
    from gml:_Feature :
    - gml:id attribute
    - gml:name
    - gml:boundedBy
  </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:complexType name="MaskFeatureType">
  <xs:complexContent>
    <xs:extension base="gml:AbstractFeatureType">
      <xs:sequence>

```

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:extentOf">
          <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 preferred 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: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="imageQualityCode" 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="composedOf" type="hma:EarthObservationPropertyType"/>
  <xs:element name="subsetOf" 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 v2004 rel. 2 U (http://www.xmlspy.com) by jrom (CNES) -->
<xs:schema targetNamespace="http://earth.esa.int/ohr" xmlns:ohr="http://earth.esa.int/ohr"
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"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="0.94">
  <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="snowCoverPercentage" type="gml:MeasureType" minOccurs="0">
            <xs:annotation>
              <xs:documentation>Must be expressed in percents</xs:documentation>
            </xs:annotation>
          </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 targetNamespace="http://earth.esa.int/sar" 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" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="0.94">
  <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:beam" 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="beam" type="xs:string"/>
<!-- ===== -->
<!-- Miscellaneous types -->
<!-- ===== -->
<xs:simpleType name="PolarisationChannelsPropertyType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="HH"/>
    <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="HV, VV"/>
    <xs:enumeration value="VH, VV"/>
    <xs:enumeration value="VH, HV"/>
    <xs:enumeration value="VH, 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
(11,12,13...17) 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 targetNamespace="http://earth.esa.int/atm" 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:atm="http://earth.esa.int/atm" elementFormDefault="qualified"
  attributeFormDefault="unqualified" version="0.94">
  <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:sequence>
  </xs:complexType>

```



```

    </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 explicitly 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:extentOf : -->
<!-- + expected contents is gml:Polygon/gml:exterior/gml:LinearRing/gml:posList. -->
<!-- ===== -->
<pattern id="footprint_extentOf" name="footprint_extentOf">
  <rule context="gml:extentOf">
    <assert test="gml:Polygon/gml:exterior/gml:LinearRing/gml:posList">gml:extentOf : expected
contents is 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>

```