OGC Name Type Specification - Sensor Models and Parameters

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OGC Name Type Specification - Sensor Models and Parameters

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i. Abstract

A wide variety of sensors have historically been used to collect geospatial data. In order to enable systems to transform the data collected by the sensors into observations that can be processes and exploited, it is often necessary to understand the characteristics of the sensors. Unfortunately, to date there has not been an industry-wide open register of sensor models and their components. To address this issue, the 2018 Orleans Technical Committee passed a motion for the OGC Naming Authority (OGC-NA) to establish a sensor model register.

The motion passed by the 2018 Orleans Technical Committee (TC) meeting read as follows: "The D&I DWG recommends that the OGC Naming Authority consider a mechanism to allow the creation of a well-defined, on-line registry capability to support registers which are recommended by a SWG or DWG. These need to be standardized and publicized in a machine-readable form with persistent identifiers. Register management will be within the scope of the OGC Naming Authority. A workflow/approval mechanism for creating and updating a Register needs to also be defined. The DWG recommends the first register considered for this registry is the Sensor Model and parameters in order to take it under the control of a standards body".

This document presents DRAFT OGC policy on the registration of sensor models and their parameters. A sensor model register provides an authoritative lookup of identifiers of sensor models and their associated components such as sensor properties, transformation polynomials, and so on.

ii. Keywords

The following are keywords to be used by search engines and document catalogues.

ogcdoc, OGC document, policy, naming authority, definitions, sensor model, parameters

iii. Preface

This document specifies a rule for constructing OGC names that may be used for identifying definitions of sensor models and their parameters. This document is a specialization of the OGC policy 'OGC-NA Name type specification - definitions: Part 1 - basic name' (OGC 09-048r3).

iv. Submitting organizations

The following organizations submitted this Document to the Open Geospatial Consortium (OGC):

Organization name(s)

v. Submitters

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

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Scott Simmons	OGC

Chapter 1. Scope

This DRAFT OGC policy applies to sensor models and their parameters. A sensor model is a type of Location Model that allows one to georegister or co-register observations from a sensor (particularly remote sensors) (OGC 12-000).

Chapter 2. Conformance

This document presents DRAFT OGC policy on the registration of sensor models and their parameters.

Conformance with this policy shall be checked using the naming rule and naming assignment policy defined in this document.

Chapter 3. References

IETF: RFC 2141 URN Syntax http://tools.ietf.org/html/rfc2141 (1997)

IETF: RFC 2616 Hypertext Transfer Protocol — HTTP/1.1 http://tools.ietf.org/html/rfc2616 (1999)

IETF: RFC 3986 Uniform Resource Identifier (URI): Generic Syntax http://tools.ietf.org/html/rfc3986 (2005)

IETF: RFC 4395 Guidelines and Registration Procedures for New URI Schemes http://tools.ietf.org/html/rfc4395 (2006)

IETF: RFC 5141 A Uniform Resource Name (URN) Namespace for the International Organization for Standardization (ISO) http://tools.ietf.org/html/rfc5141 (2008)

IETF: RFC 5165 A Uniform Resource Name (URN) Namespace for the Open Geospatial Consortium (OGC) http://tools.ietf.org/html/rfc5165 (2008)

IETF: RFC 5234 Augmented BNF for Syntax Specifications: ABNF http://tools.ietf.org/html/rfc5234 (2008)

OGC: OGC 05-020r25, Technical Committee Policies and Procedures http://docs.opengeospatial.org/pol/05-020r25/05-020r25.html (2017)

OGC: OGC 09-046r2, OGC Naming Authority – Procedures http://portal.opengeospatial.org/files/?artifact_id=37800 (2010)

OGC: OGC 09-048r3, OGC-NA Name type specification - definitions: Part 1 - basic name' http://portal.opengeospatial.org/files/?artifact_id=37802 (2010)

OGC: OGC 12-000, OGC® SensorML: Model and XML Encoding Standard https://portal.opengeospatial.org/files/?artifact_id=55939

W3C: Simple Knowledge Organization System (SKOS) https://www.w3.org/TR/2009/REC-skos-reference-20090818 (2009)

Chapter 4. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

For the purposes of this document, the following additional terms and definitions apply.

4.1. Observation

Act of observing a property or phenomenon [ISO 19156, definition 4.10] Note: The goal of an observation may be to measure, estimate or otherwise determine the value of a property.

4.2. Sensor

An entity capable of observing a phenomenon and returning an observed value. Type of observation procedure that provides the estimated value of an observed property at its output. Note: A sensor uses a combination of physical, chemical or biological means in order to estimate the underlying observed property. At the end of the measuring chain electronic devices often produce signals to be processed. (OGC 12-000)

4.3. Sensor Model

A geopositioning mathematical description of the relationship between the three-dimensional object space and the two-dimensional plane of the associated image produced by a sensor (ISO/TS 19130)

4.4. (Sensor) Platform

An entity to which can be attached sensors or other platforms. A platform has an associated local coordinate reference frame that can be referenced relative to an external coordinate reference frame and to which the reference frames of attached sensors and platforms can be referenced.(OGC 12-000)

Chapter 5. Conventions

This document uses the normative terms (SHALL, SHOULD, etc) defined in Subclause 5.3 of [OGC 06-121r3], which is based on the ISO/IEC Directives, Part 2: Rules for the structure and drafting of International Standards. In particular, the word 'shall' (not 'must') is the verb form used to indicate a requirement to be strictly followed to comply with this specification.

Name production rules in this document are expressed using ABNF (IETF RFC 5324).

The namespaces and prefixes used in this document are introduced in the following table.

Prefix	Namespace
owl	http://www.w3.org/2002/07/owl#
rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
skos	http://www.w3.org/2004/02/skos/core#
dcterms	http://purl.org/dc/terms/
rdfs	http://www.w3.org/2000/01/rdf-schema#
dc	http://purl.org/dc/elements/1.1/
status	http://www.opengis.net/def/status/
policy	http://www.opengis.net/def/metamodel/ogc-na/

Chapter 6. Naming Rule

This section describes the naming rule. The section is taken from the OGC policy 'OGC-NA Name type specification - definitions: Part 1 - basic name' (OGC 09-048r3).

6.1. OGC name schemes

Two URI schemes [IETF RFC 3986] are defined by OGC to provide persistent names for resources of interest in geographic information infrastructures. These include schemas for URNs and HTTP URIs. The register of sensor models and parameters uses HTTP URIs as identifiers. The URIs are grounded on the www.opengis.net domain to ensure OGC is able to provide persistent resolvability of the URIs. The identifiers can be used across OGC standards to refer to parameters that have the same semantics.

The generic syntax for OGC http URIs is

```
URI = "http://www.opengis.net/" OGCResource "/" ResourceSpecificPath
```

The following ABNF adapted from [IETF RFC 3986] provides some basic definitions required in the rest of this document.

```
segment       = *pchar
segment-nc    = *pchar-nc
segment-nz    = 1*pchar
segment-nz-nc = 1*pchar-nc
pchar         = unreserved / pct-encoded / sub-delims / ":" / "@"
pchar-nc      = unreserved / pct-encoded / sub-delims / "@"
pct-encoded   = "%" HEXDIG HEXDIG
unreserved    = ALPHA / DIGIT / "-" / "." / "_" / "~"
reserved      = gen-delims / sub-delims
gen-delims    = ":" / "/" / "?" / "#" / "[" / "]" / "@"
sub-delims    = "!" / "$" / "&" / "'" / "(" / ")"
              / "*" / "+" / "," / ";" / "="
```

6.2. Production rule for specification element names

The basic form for an OGC name that identifies a definition shall be produced using the following rule:

```
OGCResource   = "def"
ResourceSpecificPath = definition-type "/" authority "/" version "/" code
ResourceSpecificString = definition-type ":" authority ":" versionURN ":" codeURN
definition-type = segment-nz-nc ; a token from the register of OGC definition types
authority     = segment-nz-nc ; a token from the register of OGC authorities
version       = segment-nz-nc / "0" ; use 0 for un-versioned names
code          = segment-nz-nc *( "/" segment-nz-nc )
versionURN    = segment-nc ; this may be a zero-length string
codeURN       = segment-nz-nc *( ":" segment-nz-nc )
```

"version" or "versionURN" is a required field. For un-versioned definitions:

- within the http URI form the version field shall be "0"
- within the URN form versionURN shall be a zero-length string—so an un-versioned definition can be detected by a pair of colons "::".

The actual code may be composed of a sequence of fields delimited by "/" in the http URI form, or ":" in the URN form.

6.3. Additional rules specific to sensor models

The following additional rules apply to sensor models:

1. The **definition-type** in a URI identifying a sensor model shall be set as "sensor-model"
2. The **code** segment of a URI identifying a sensor model shall begin with the acronym or UpperCamelCase name of the specification to which the sensor model belongs (e.g. NITF)

An example URI conforming to the rules listed above is http://www.opengis.net/def/sensor-model/NTB/2.1/NITF/RPC00B

The example is based on the National Imagery Transmission Format (NITF)[MIL-STD-2500C] and its Rapid Positioning Capability extension (RPC00B) [STDI-0002 App E]. In the example URI above, the NTB (NITF Technical Board) is the authority, the version number is 2.1, the specification is NITF and the sensor model name is RPC00B (in this case, the name of the NITF extension).

NOTE	The RPC00B contains rational function polynomial coefficients and normalization parameters that define the physical relationship between image coordinates and ground coordinates. That is, the extension is based on Rational Polynomial Coefficients (RPC).

6.4. Additional rules specific to sensor model parameters

The following additional rules apply to sensor model parameters:

1. The **definition-type** in a URI shall be set as "sensor-model-param"

2. The **code** segment of a URI shall begin with the acronym or UpperCamelCase name of the specification to which the sensor model parameter belongs (e.g. NITF)
3. The last sub-segment of the **code** segment shall be a name unique within the sensor model
4. The **code** segment of a URI may optionally include a sub-segment identifying the sensor model and/or other containers of the sensor model parameter.

An example URI conforming to the rules listed above is http://www.opengis.net/def/sensor-model-param/NTB/2.1/NITF/RPC00B/LINE_OFF

In the example URI above, the NTB is the authority, the version number is 2.1, the specification is NITF, the sensor model is RPC00B, the sensor model parameter is LINE_OFF.

Chapter 7. Name Assignment Policy

7.1. Sensor Models

The register of sensor models http://www.opengis.net/register/ogc-na/sensor-model is controlled by OGC-NA. Changes to this register (additions, deletions, and supersession) shall be initiated by a submission to the OGC Naming Authority names@opengeospatial.org.

7.2. Sensor Model Parameters

The register of sensor model parameters http://www.opengis.net/register/ogc-na/sensor-model-param is controlled by OGC-NA. Changes to this register (additions, deletions, and supersession) shall be initiated by a submission to the OGC Naming Authority names@opengeospatial.org.

7.3. Description

Each sensor model parameter shall be described using the Simple Knowledge Organization System (SKOS) vocabulary of the World Wide Web (W3C) consortium. Other vocabularies may also be used **in addition** to SKOS, for example the OGC Semantic Registry Information Model (SRIM) [1].

The following predicates are mandatory for describing sensor model and parameter resources:

- **skos:prefLabel** for providing a human-readable version of a resource's name
- **dcterms:created** for stating the date the resource was created in the register
- **dcterms:modified** for stating the date the resource was modified in the register (mandatory if the resource has been modified)
- **policy:status** for indicating whether the resource is valid, retired, superseded, or under consideration
- **skos:definition** for providing a human-readable description of the resource
- **skos:inScheme** for stating the Concept Scheme to which the resource belongs
- **rdfs:label** for providing a human-readable version of a resource's name (used for compatibility with non-SKOS systems)

An example of the use of the above-listed predicates is presented below in the Turtle format of the Resource Description Framework (RDF). Note that individual sensor model parameters are described as instances of the SKOS Concept class, whereas sensor models are described as instances of the SKOS ConceptScheme class.

```
<http://www.opengis.net/def/sensor-model/NTB/2.1/NITF/RPC00B>
        a                   skos:ConceptScheme ;
        rdfs:label          "NITF Rapid Positioning Capability" ;
        dcterms:created     "2018-03-13"^^<http://www.w3.org/2001/XMLSchema#date> ;
        dcterms:modified    "2018-04-16"^^<http://www.w3.org/2001/XMLSchema#date> ;
        policy:status       status:valid ;
        skos:definition     "The sensor model supported by the RPC00B extension of the
NITF standard contains rational function polynomial coefficients and normalization
parameters that define the physical relationship between image coordinates and ground
coordinates." ;
        skos:prefLabel      "NITF Rapid Positioning Capability" ;
        skos:broader       <http://www.opengis.net/def/sensor-
model/OGC/0/RationalPolynomialCoefficients> .


<http://www.opengis.net/def/sensor-model-param/NTB/2.1/NITF/RPC00B/LINE_OFF>
        a                   skos:Concept ;
        rdfs:label          "Line Offset" ;
        dcterms:created     "2018-03-13"^^<http://www.w3.org/2001/XMLSchema#date> ;
        dcterms:modified    "2018-04-16"^^<http://www.w3.org/2001/XMLSchema#date> ;
        policy:status       status:valid ;
        skos:definition     "Line Offset" ;
        skos:inScheme       <http://www.opengis.net/def/sensor-
model/NTB/2.1/NITF/RPC00B> ;
        skos:prefLabel      "Line Offset" .
```

Note the use of the SKOS **broader** predicate to represent the relationship of the sensor model adopted by RPC00B to the Rational Polynomial Coefficients model [2].

Chapter 8. Examples

http URI form:

http://www.opengis.net/def/definition-type/Authority/0/code

This policy has been designed to be able to support registration of models such as the: Community Sensor Model (CSM) [3], Generic Point Cloud Model (GPM) [4], Frame Sensor Model [5], Pushbroom/Whiskbroom Sensor Model [6], Light Detection and Ranging (LiDAR) Sensor Model [7], Spotlight Synthetic Aperture Radar (SAR) Sensor Model [8] and others defined in ISO/TS 19130-2 [9] and extensions of the National Imagery Transmission Format (NITF) standard [10].

The following examples use ISO 19130 [11] and NITF sensor model parameters [12] to illustrate how to construct an http URI based on this OGC policy. The NITF examples are based on the SENSRB extension [13]. The examples have been informed by lessons learnt from the OGC Testbed series [14].

Example 1, below, illustrates an http URI value for the ISO 19130 True Replacement Model:

http://www.opengis.net/def/sensor-model/ISO/0/ISO-19130/SD_SensorModel/trueReplacementModel/SD_TrueReplacementModel

Example 2, below, illustrates an http URI value for the NITF RPC00B model:

http://www.opengis.net/def/sensor-model/NTB/2.1/NITF/RPC00B

Example 3, below, illustrates the http URI value for the 'region of validity' parameter of the ISO 19130 True Replacement Model:

http://www.opengis.net/def/sensor-model-param/ISO/0/ISO-19130/SD_TrueReplacementModel/regionOfValidity

Example 4, below, illustrates the http URI value for the LAT_OFF parameter of the NITF RPC00B model [10].

http://www.opengis.net/def/sensor-model-param/NTB/2.1/NITF/RPC00B/LAT_OFF

NOTE	SENSRB is a NITF tagged record extension for imaging electro-optical sensors [STDI-0002 App Z]. It was developed to enable the storage and use of geometric parameters from electro-optical sensor systems. It provides an encoding scheme to support implementation of the Community Sensor Model (CSM) Working Group's guidance on geopositioning from frame, pushbroom, and whiskbroom sensors.

Example 5, below, illustrates the http URI value for the REFERENCE_ROW field of the NITF SENSRB extension:

http://www.opengis.net/def/sensor-model-param/NTB/2.1/NITF/SENSRB/REFERENCE_ROW

Example 6, below, illustrates where the field is nested inside other objects and the hierarchy of nesting objects is identified as separate sections of the URI. The http URI value for the

PLATFORM_HEADING field, contained inside a ATTITUDE_EULER_ANGLES object of the NITF SENSRB extension is:

http://www.opengis.net/def/sensor-model-param/NTB/2.1/NITF/SENSRB/ATTITUDE_EULER_ANGLES/PLATFORM_HEADING

Annex A: Usage with SensorML (Informative)

A.1. Introduction

The OGC Sensor Model Language (SensorML) standard provides the means of semantically defining processes and their associated components with the measurement and post-measurement transformation of observations. Whereas the standard provides the means to describe sensor characteristics, it allows implementations to use their own identifiers for referencing their sensor characteristics. This enables interoperability by allowing the sensor characteristics to be described in a consistent syntax, however it also requires that applications attempting to interpret the sensor model descriptions understand the meaning of the identifiers before hand.

A.2. Examples

The following is an example of how to use OGC-registered ISO URIs with SensorML.

```
<sml:SimpleProcess gml:id="example.1"
xmlns:sml="http://www.opengis.net/sensorml/2.0"
xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://www.opengis.net/sensorml/2.0
http://schemas.opengis.net/sensorML/2.0/sensorML.xsd"
definition="http://www.opengis.net/def/sensor-model/ISO/0/ISO-
19130/SD_SensorModel/trueReplacementModel/SD_TrueReplacementModel">
    <sml:parameters>
        <sml:ParameterList>
            <sml:parameter name="regionOfValidity">
                <swe:DataRecord definition="http://www.opengis.net/def/sensor-model-
param/ISO/0/ISO-19130/SD_TrueReplacementModel/regionOfValidity">
                    <swe:label>True Replacement Model regionOfValidity</swe:label>
                    <swe:field name="gridPoints">
                       <swe:Vector
referenceFrame="http://www.opengis.net/def/cs/OGC/0/CartesianIndexed2D">
                          <swe:coordinate name="gridPoint1">
                             <swe:Quantity
definition="http://www.opengis.net/ont/gml#Point">
                                <swe:uom code="GridSpacing"/>
                             </swe:Quantity>
                          </swe:coordinate>
                          <swe:coordinate name="gridPoint2">
                             <swe:Quantity
definition="http://www.opengis.net/ont/gml#Point">
                                <swe:uom code="GridSpacing"/>
                             </swe:Quantity>
                          </swe:coordinate>
                          <swe:coordinate name="gridPoint3">
                             <swe:Quantity
definition="http://www.opengis.net/ont/gml#Point">
                                <swe:uom code="GridSpacing"/>
                             </swe:Quantity>
                          </swe:coordinate>
                          <swe:coordinate name="gridPoint4">
                             <swe:Quantity
definition="http://www.opengis.net/ont/gml#Point">
                                <swe:uom code="GridSpacing"/>
                             </swe:Quantity>
                          </swe:coordinate>
                       </swe:Vector>
                    </swe:field>
                </swe:DataRecord>
            </sml:parameter>
        </sml:ParameterList>
    </sml:parameters>
</sml:SimpleProcess>
```

The following is an example of how to use OGC-registered NITF URIs with SensorML.

```
<sml:SimpleProcess gml:id="example.2"
xmlns:sml="http://www.opengis.net/sensorml/2.0"
xmlns:swe="http://www.opengis.net/swe/2.0"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://www.opengis.net/sensorml/2.0
http://schemas.opengis.net/sensorML/2.0/sensorML.xsd"
definition="http://www.opengis.net/def/sensor-model/NTB/2.1/NITF/SENSRB">
    <sml:parameters>
        <sml:ParameterList>
            <sml:parameter name="sensrbParams">
                <swe:DataRecord definition="http://www.opengis.net/def/sensor-model-
param/NTB/2.1/NITF/SENSRB/">
                    <swe:label>NITF SENSRB Sensor Model Parameters (subset
of)</swe:label>
                    <swe:field name="referenceRow">
                        <swe:Quantity definition="http://www.opengis.net/def/sensor-
model-param/NTB/2.1/NITF/SENSRB/REFERENCE_ROW">
                            <swe:label>Reference Row</swe:label>
                            <swe:uom code="pixel"/>
                        </swe:Quantity>
                    </swe:field>
                    <swe:field name="SENSOR_CALIBRATION_DATA">
                        <swe:DataRecord>
                            <swe:label>Sensor Calibration Data</swe:label>
                            <swe:field name="PRINCIPAL_POINT_OFFSET_X">
                                <swe:Quantity
definition="http://www.opengis.net/def/sensor-model-
param/NTB/2.1/NITF/SENSRB/SENSOR_CALIBRATION_DATA/PRINCIPAL_POINT_OFFSET_X">
                                    <swe:label>PRINCIPAL_POINT_OFFSET_X</swe:label>
                                    <swe:uom code="pixel"/>
                                </swe:Quantity>
                            </swe:field>
                            <swe:field name="PRINCIPAL_POINT_OFFSET_Y">
                                <swe:Quantity
definition="http://www.opengis.net/def/sensor-model-
param/NTB/2.1/NITF/SENSRB/SENSOR_CALIBRATION_DATA/PRINCIPAL_POINT_OFFSET_Y">
                                    <swe:label>PRINCIPAL_POINT_OFFSET_Y</swe:label>
                                    <swe:uom code="pixel"/>
                                </swe:Quantity>
                            </swe:field>
                        </swe:DataRecord>
                    </swe:field>
                </swe:DataRecord>
            </sml:parameter>
        </sml:ParameterList>
    </sml:parameters>
</sml:SimpleProcess>
```

Annex B: Revision History

Date	Release	Editor	Primary clauses modified	Description
2018-04-13	0.1	G. Hobona	all	Initial draft document
2018-04-27	0.2	G. Hobona	all	Revised based on feedback from contributors
2018-05-14	0.3	G. Hobona	annex a	Schema validated SensorML examples
2018-05-17	0.4	G. Hobona	all	Automated bibliography added. Cited additional GWG resources.

Annex C: Bibliography

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