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Editor: Peter Baumann, Stephan Meissl

OGC® Web Coverage Service 2.0 Interface Standard - Earth Observation Application Profile

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i. Preface

This document specifies an Application Profile of the OGC Web Coverage Service (WCS).

Suggested additions, changes, and comments on this draft document 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. Terms and definitions

This document uses the standard terms defined in Subclause 5.3 of [OGC 06-121r9], 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.

iii. Submitting organizations

The following organizations have submitted this Interface Specification to the Open GeoSpatial Consortium, Inc.:

- Jacobs University Bremen
- EOX IT Services GmbH
- G.I.M. Geographic Information Management nv/sa
- European Space Agency (ESA)
- Spot Image

Additionally, rasdaman GmbH has made substantial contributions.

iv. Document Contributor Contact Points

Name	Organization
Peter Baumann	Jacobs University Bremen, rasdaman GmbH
Jinsongdi Yu	Jacobs University Bremen
Stephan Meissl	EOX IT Services GmbH
Christian Schiller	EOX IT Services GmbH

v. Revision history

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2011-01-19	0.2.0	Jinsongdi Yu	Annex A	Added ATS

vi. Changes to the OpenGIS® Abstract Specification

The OpenGIS® Abstract Specification does not require any changes to accommodate the technical contents of this (part of this) document.

vii. Future Work

Among the topics for future development are the following items:

- Extend the current 2-D EO Coverage footprint to 3-D footprints by extending them with elevation; this will involve extending footprints from bounding multi-curves (polygons) to multi-surfaces.
- Resolve editors' questions and TBDs.
- Align with forthcoming WCS 2.0 extensions once available.

Foreword

This WCS Application Profile for Earth Observation is an OGC Interface Standard which relies on WCS 2.0 (the Core [OGC 09-110r3] plus selected extensions), the GML Application Schema for Coverages [OGC 09-146r1], the Earth Observation Metadata Profile of Observations and Measurements [OGC 10-157r2], and GML 3.2.1 [OGC 07-036].

This document includes one annex; this annex is normative.

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Introduction

The OGC *Web Coverage Service (WCS) Application Profile – Earth Observation*, in short: EO-AP, specializes the generic WCS 2.0 [OGC 09-110r3] for use on Earth Observation data. An Application Profile bundles several specifications and possibly adds additional requirements on an implementation. Extra requirements can be additions (for example, Dataset Series are introduced by this specification) or constraints (for example, coverages offered are restricted to 2-D rasters).

The EO-AP provides the following specification elements:

- Definition of specific Earth Observation coverages (EO Coverages) which have a *latitude/longitude* or projected *x/y* spatial extent and a temporal validity extent. EO Coverages are derived from Referenceable Grid Coverages and Rectified Grid Coverages as defined in the GML Application Schema for Coverages [OGC 09-146r1]. Each EO Coverage has an EO metadata set [OGC 10-157r2] contained in its metadata which describes the coverage on hand on a higher semantic level.
- Definition of a hierarchy which allows to group EO Coverages suitably for an efficient retrieval:
 - Datasets as plain 2-D EO Coverages (and, hence, accessible as coverages);
 - Stitched Mosaics as homogeneous collections of spatially non-overlapping subsets of Datasets, accessible as coverages;
 - Dataset Series as collections of Stitched Mosaics and/or Datasets; Dataset Series are not coverages.
- Bundling of several mandatory and optional WCS extensions for EO-AP implementations.

OGC® Web Coverage Service 2.0 Interface Standard – Earth Observation Application Profile

1 Scope

This OGC WCS Application Profile – Earth Observation Interface Standard – henceforth abbreviated as: *Earth Observation Application Profile (EO-AP)* – defines data structures and operations which together allow retrieval of Earth Observation coverages offered by a WCS 2.0 server.

2 Conformance

Standardisation target are WCS implementations (currently: servers). This document specifies three conformance classes. Annex A specifies compliance tests which shall be exercised on any implementation claiming to implement the Earth Observation Application Profile.

This document establishes the following requirements and conformance classes:

- *ap-eo*, of URI http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/req/ap-eo, defining the Earth Observation Application Profile on conceptual level; the corresponding conformance class is *ap-eo*, with URI http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/conf/ap-eo.
- *ap-eo_get-kvp*, of URI http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/req/ap-eo_get-kvp, defining the GET-KVP protocol binding of the Earth Observation Application Profile; the corresponding conformance class is *ap-eo_get-kvp*, with URI http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/conf/ap-eo_get-kvp.
- *ap-eo_soap*, of URI http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/req/ap-eo_soap, defining the SOAP protocol binding of the Earth Observation Application Profile on conceptual level; the corresponding conformance class is *ap-eo_soap*, with URI http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/conf/ap-eo_soap.

Requirements and conformance test URIs defined in this document are relative to http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/.

Annex A lists the conformance tests which shall be exercised on any software artefact claiming to implement the Earth Observation Application Profile.

3 Normative references

This *OGC WCS Application Profile – Earth Observation* specification consists of the present document and an XML Schema. The complete specification is identified by OGC URI http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/, the document

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has OGC URI http://www.opengis.net/doc/ISx/WCS_application-profile_earth-observation/1.0.

The complete specification is available for download from <http://www.opengeospatial.org/standards/wcs>; additionally, the XML Schema is posted online at <http://schemas.opengis.net/wcseo/1.0> as part of the OGC schema repository. In the event of a discrepancy between bundled and schema repository versions of the XML Schema files, the schema repository shall be considered authoritative.

The following normative documents contain provisions that, through reference in this text, constitute provisions of this specification. 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 06-121r9 *OGC Web Services Common Standard*, version 2.0

OGC 07-036, *Geography Markup Language (GML) Encoding Standard*, version 3.2.1

Conformance classes used:

- TBD

OGC 09-146r1, *GML 3.2.1 Application Schema for Coverages*, version 1.0

Conformance classes used:

- gml-coverage

OGC 09-110r3, OGC® *Web Coverage Service 2.0 Interface Standard Core*, version 2.0

Conformance classes used:

- core

OGC 10-XXX, OGC® *WCS 2.0 Interface Standard – Range Subsetting Service Model Extension*, version 1.0

Conformance classes used:

- range-subsetting

OGC 10-XXX, OGC® *WCS 2.0 Interface Standard – Scaling & Interpolation Service Model Extension*, version 1.0

Conformance classes used:

- scaling-interpolation

OGC 10-XXX, OGC® *WCS 2.0 Interface Standard – Predefined CRS Service Model Extension*, version 1.0

Conformance classes used:

- crs-predefined

OGC 10-XXX, OGC® *WCS 2.0 Interface Standard – Non-Referenced Data Model Extension*, version 1.0

Conformance classes used:

- TBD

OGC 09-147r1, OGC® *WCS 2.0 Interface Standard – KVP Protocol Binding Extension*, version 1.0

Conformance classes used:

- get-kvp

OGC 09-149r1, OGC® *WCS 2.0 Interface Standard – SOAP Protocol Binding Extension*, version 1.0

Conformance classes used:

- soap

OGC 10-XXX, OGC® *WCS 2.0 Interface Standard – Encoding Format Extension*, version 1.0

Conformance classes used:

- gml

OGC 10-147, OGC® *WCS 2.0 Interface Standard – GeoTIFF Encoding Format Extension*, version 1.0

Conformance classes used:

- geotiff

OGC 10-XXX, OGC® *WCS 2.0 Interface Standard – NetCDF Encoding Format Extension*, version 1.0

Conformance classes used:

- netcdf

OGC 10-XXX, OGC® *WCS 2.0 Interface Standard – JPEG2000 Encoding Format Extension*, version 1.0

Conformance classes used:

- jpeg2000

OGC 10-157r2, *Earth Observation Metadata Profile of Observations and Measurements*

Conformance classes used:

- TBD

4 Terms and definitions

For the purposes of this document, the terms and definitions given in the above references apply. In addition, the following terms and definitions apply.

4.1 Coverage

coverage as defined in [OGC 09-146r1]

4.2 Dataset

2-D → EO Coverage

NOTE A Dataset usually represents observations obtained by satellite instruments.

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4.3 Dataset Series

collection of → EO Coverages

4.4 EO Coverage

Rectified Grid → Coverage or Referenceable Grid → Coverage having an → EO Metadata record and a WGS84 bounding box

4.5 EO Metadata

→ EO Coverage's metadata record

4.6 Stitched Mosaic

→ EO Coverage composed from subsets of one or more co-referenced → Datasets

4.7 Lineage record

Data structure documenting an operation that has been applied to the → coverage it is part of

4.8 refers to

contains, in its → EO Metadata element as defined in [OGC 10-157r2], the → EO Metadata element of

5 Conventions

5.1 UML notation

Unified Modeling Language (UML) static structure diagrams appearing in this specification are used as described in Subclause 5.2 of OGC Web Services Common [OGC 06-121r9].

5.2 Data dictionary tables

The UML model data dictionary is specified herein in a series of tables. The contents of the columns in these tables are described in Subclause 5.5 of [OGC 06-121r9]. The contents of these data dictionary tables are normative, including any table footnotes.

5.3 Namespace prefix conventions

The following namespaces are used in this document. The prefix abbreviations used constitute conventions used here, but are **not** normative. The namespaces to which the prefixes refer are normative, however.

Table 1 — Namespace mappings

Prefix	Namespace URI	Description
xsd	http://www.w3.org/2001/XMLSchema	XML Schema namespace

gml	http://www.opengis.net/gml/3.2	GML 3.2.1
gmlcov	http://www.opengis.net/gmlcov/1.0	GML Application Schema for Coverages 1.0
wcs	http://www.opengis.net/wcs/2.0	WCS 2.0
eop	http://www.opengis.net/eop/2.0	Earth Observation Metadata Profile of Observations and Measurements
opt	http://www.opengis.net/opt/2.0	Optical Earth Observation Metadata Profile of Observations and Measurements (extension of eop)
sar	http://www.opengis.net/sar/2.0	SAR Earth Observation Metadata Profile of Observations and Measurements (extension of eop)
wcseo	http://www.opengis.net/wcseo/1.0	WCS Application Profile – Earth Observation 1.0

5.4 Multiple representations

When multiple representations of the same information are given in a specification document these are consistent. Should this not be the case then this is considered an error, and the XML schema shall take precedence.

6 EO data model

6.1 Overview

The data model of this EO-AP centers around the data structure of an Earth Observation coverage (EO Coverage), which is a coverage extended with EO Metadata [OGC 10-157r2] and bound to a location on the Earth. EO Coverages are a subtype of either `GMLCOV::RectifiedGridCoverage` or `GMLCOV::ReferenceableGridCoverage`.

Based on this EO Coverage concept (cf. Subclause 6.3), three main data elements are defined:

- A *Dataset* is a 2-D horizontal EO Coverage, which can represent, for example, a hyperspectral satellite scene; cf. Subclause 6.4. A Dataset can be a Rectified Dataset or a Referenceable Dataset, depending on the type of EO Coverage it is derived from.
- A *Stitched Mosaic* is a collection of 2-D horizontal EO Coverages referring to co-referenced Datasets; cf. Subclause 6.5. A Stiche Mosaic can be a Rectified Stiche Mosaic or a Referenceable Stiche Mosaic, depending on the type of EO Coverage it is derived from. A Stiche Mosaic can be interpreted (i.e., requested) as a single coverage.

- A *Dataset Series* is a collection of coverages; cf. Subclause 6.6. A Dataset Series can refer to any number of Datasets and Stitched Mosaics. A Dataset Series is not a coverage itself.

Figure 1 informally symbolizes how the concepts of Dataset, Stitched Mosaic, and Dataset Series relate to each other spatio-temporally:

- A – a Dataset with a particular validity in time;
- B – a Stitched Mosaic; all its Datasets have a spatial extent contained in the Stitched Mosaic’s spatial extent and a timespan contained in the Stitched Mosaic’s time interval. The subsets contributing to the Stitched Mosaic do not overlap in space, but there may be empty (nil) areas.
- C – the overall Dataset Series combining Datasets and Stitched Mosaics.

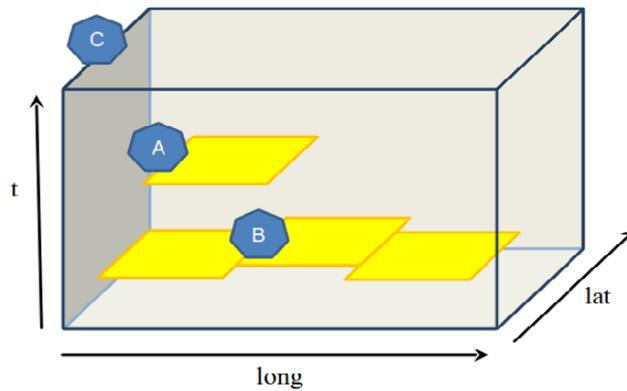


Figure 1 — Conceptual view of a Dataset Series with Stitched Mosaic and Dataset

Figure 2 contains the UML diagram defining classes (types) and their correlations in the EO-AP.

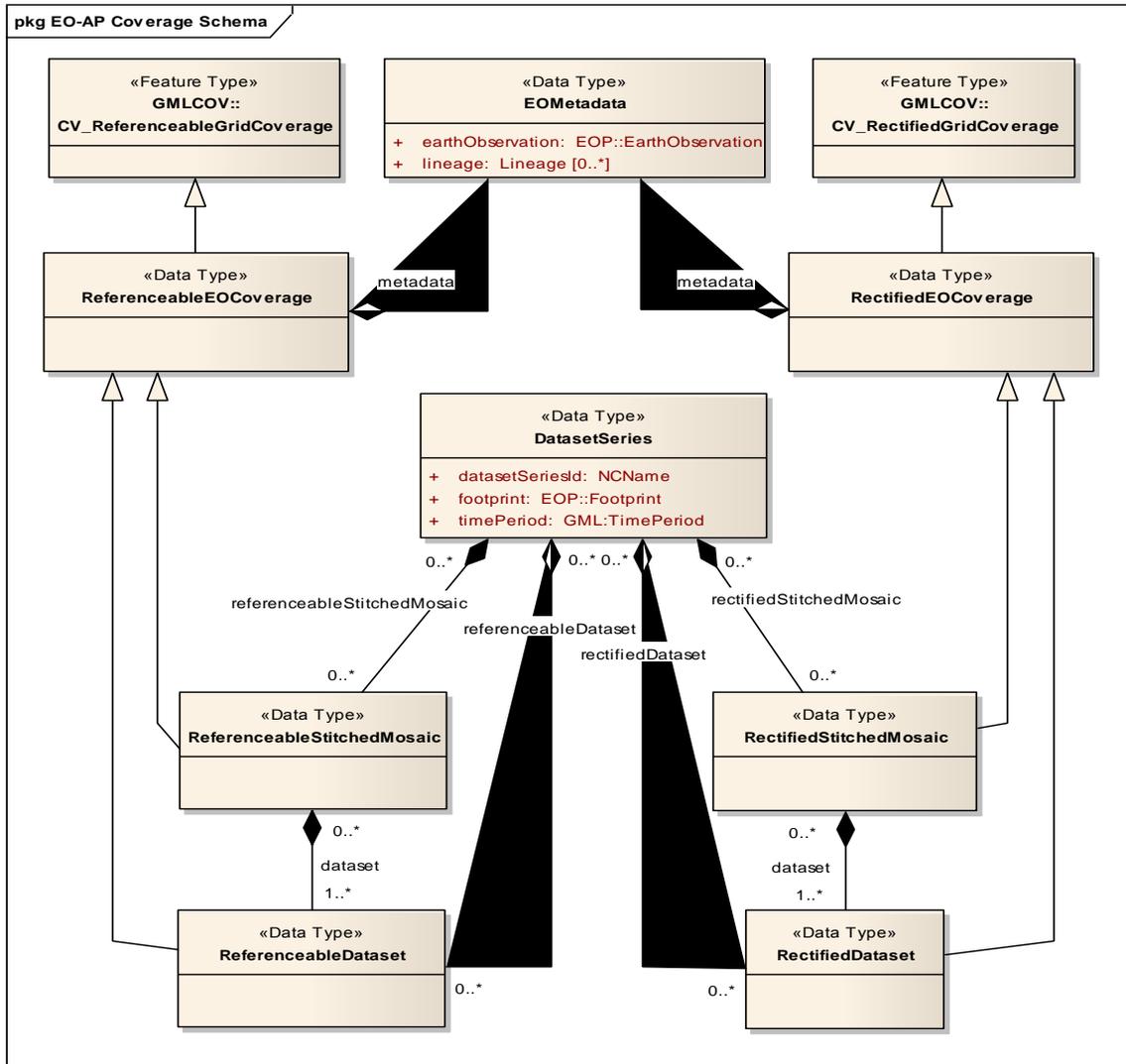


Figure 2 — UML Model of EO Application Profile Schema

6.2 EO Metadata

Every EO Coverage contains *EO Metadata*, consisting of an EarthObservation record as defined in the OGC Earth Observation Metadata Profile of Observations and Measurements [OGC 10-157r2] and a lineage describing the history of operations leading to the coverage on hand.

Requirement 1 /req/ap-eo/eo-metadata-structure:

A `WCSEO::EOMetadata` instance **shall** conform to Table 2, Figure 2, and the XML schema being part of this standard.

Table 2 — Components of `WCSEO::EOMetadata` structure

Name	Definition	Data type	Multiplicity
earth-	EO metadata record for this	EOP::Earth-	one

Observation	coverage object	Observation	(mandatory)
lineage	History record describing an operation that has been applied to this object	WCSEO::Lineage	zero or more (optional)

NOTE Throughout this standard, `eop:` and `EOP::` can be substituted by `opt:` and `OPT::` or `sar:` and `SAR::`, respectively, as in [OGC 10-157r2] `opt:` and `sar:` are in the substitution group of `eop:`.

The footprint of an EO Coverage, which contains one or more bounding polygons to describe the region of valid data more accurately than the EO Coverage’s bounding box, is mandatory as opposed to [OGC 10-157r2].

Requirement 2 /req/ap-eo/footprint-in-eo-metadata:

The `WCSEO::EOMetadata` element of `WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** contain an `eop:EarthObservation/om:featureOfInterest/eop:Footprint` element.

NOTE As per [OGC 10-157r2], the footprint is given in WGS84.

6.3 EO Coverage

6.3.1 Overview

An *EO Coverage* is a coverage as defined in the GML Application Schema for Coverages [OGC 09-146r1]. EO Coverages appear in two variants:

- *Rectified EO Coverages* are derived from Rectified Grid Coverage as defined in [OGC 09-146r1];
- *Referenceable EO Coverages* are derived from Referenceable Grid Coverage as defined in [OGC 09-146r1].

Requirement 3 /req/ap-eo/eo-coverage-structure:

`WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** conform to Figure 2 and the XML schema being part of this standard.

6.3.2 EO Metadata

An EO Coverage has an EO Metadata record associated.

Requirement 4 /req/ap-eo/eo-metadata-in-eo-coverage:

`WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** contain one metadata element of type `WCSEO::EOMetadata`.

NOTE 1 Besides this specific metadata element there may be further metadata elements.

NOTE 2 According to the rules of GML, a `xlink:href` URI to an accessible element of type `WCSEO::EOMetadata` can be provided instead of the element itself in any place of the XML schema where such a metadata record appears.

The EO Metadata record associated with an EO Coverage contains a back reference to the coverage.

Requirement 5 /req/ap-eo/eop-identifier-in-eo-metadata:

The `WCSEO::EOMetadata` element of `WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** contain an element `eop:EarthObservation/eop:metadataProperty/eop:EarthObservationMetadata/eop:identifier` whose first word is identical to the EO Coverage identifier.

NOTE Normally, this word acting as coverage identifier will be the only contents of the `eop:identifier` string.

6.3.3 Spatio-temporal extent

The EO coverage's extent of valid data is given by its EO Metadata footprint, which refines the coverage's envelope.

Requirement 6 /req/ap-eo/boundedBy-in-eo-coverage:

`WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** contain a `gml:boundedBy` element with a `gml:Envelope` containing an `srsName` attribute value identifying WGS84.

Requirement 7 /req/ap-eo/footprint-inside-boundedBy:

In `WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances, all polygons listed in `eop:EarthObservation/om:featureOfInterest/eop:Footprint` element **shall** be contained in the bounding box of the `gml:boundedBy` element of the `gml:Envelope`.

NOTE By definition, both footprint and bounding box are expressed in WGS84.

An EO Coverage has a time period of validity associated.

Requirement 8 /req/ap-eo/phenomenonTime-in-eo-metadata:

The `WCSEO::EOMetadata` element of a `WCSEO::ReferenceableEOCoverage` or `WCSEO::RectifiedEOCoverage` instance **shall** contain elements `eop:EarthObservation/om:phenomenonTime/gml:TimePeriod/gml:beginPosition` and `eop:EarthObservation/om:phenomenonTime/gml:TimePeriod/gml:endPosition` where $beginPosition \leq endPosition$.

NOTE This typically is the time period where image acquisition has taken place.

Requirement 9 /req/ap-eo/phenomenonTime-iso8601:

For any given EO Coverage, its temporal validity values **shall** be expressed in ISO 8601 [2].

6.3.4 Range set

Requirement 10/req/ap-eo/range-set-of-eo-coverage:

In `WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances, all cells whose locations are outside the EO Metadata footprint when both are evaluated in WGS84, **shall** contain some nil value as defined in the bounding EO Coverage's range type.

6.4 Dataset

A *Dataset* is an EO Coverage as symbolized in Figure 3. A Dataset is either a Referenceable Dataset or a Rectified Dataset, derived from `WCSEO::ReferenceableEOCoverage` or `WCSEO::RectifiedEOCoverage`, respectively.

NOTE Typically, a Dataset represents a (single- or multi-band) satellite image scene.

Requirement 11/req/ap-eo/dataset-structure:

A `WCSEO::ReferenceableDataset` and a `WCSEO::RectifiedDataset` shall conform to Figure 2 and the XML schema being part of this standard.

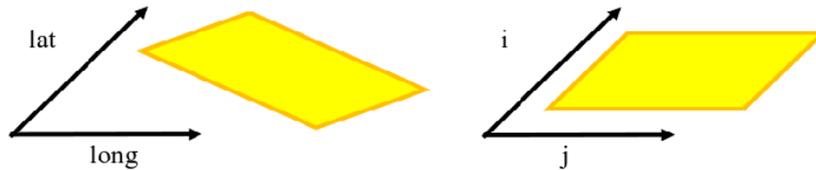


Figure 3 — Conceptual view of a Dataset as a 2-D coverage: in referenced (left) and unreferenced coordinates (right)

NOTE This definition includes the “field-of-View” of a sensor, or “cut”, according to sensor specific data specification at the resolution of the sensor (also referred to as Level-0 or Level-1 data).

6.5 Stitched Mosaic

6.5.1 Overview

A *Stitched Mosaic* is an identifiable, queryable, referenced EO Coverage as symbolized in Figure 4. A Stitched Mosaic is either a Referenceable Stitched Mosaic or a Rectified Stitched Mosaic, derived from `WCSEO::ReferenceableEOCoverage` or `WCSEO::RectifiedEOCoverage`, respectively.

Stitched Mosaics *refer to* one or more Datasets. All cells within a Stitched Mosaic which are not located inside any contributing Footprint of any of the contained Datasets carry nil values.

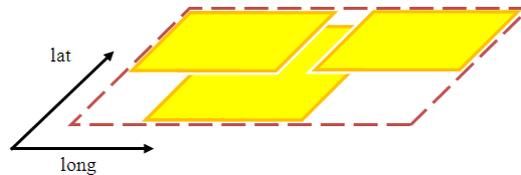


Figure 4 — Conceptual view of a Stitched Mosaic as a 2-D coverage: composed from Datasets (Stitched Mosaic bounding box dashed)

Requirement 12/req/ap-eo/referenceableStitchedMosaic-structure:

`WCSEO::ReferenceableStitchedMosaic` instances shall conform to Figure 2, Table 3, Table 5, and the XML schema being part of this standard.

Table 3 — Components of `WCSEO::ReferenceableStitchedMosaic` structure

Name	Definition	Data type	Multiplicity
dataset	Reference to a Referenceable Dataset referred to by the Stitched Mosaic on hand	WCSEO::DatasetReference	one or more (mandatory)

Requirement 13/req/ap-eo/rectifiedStitchedMosaic-structure:

WCSEO::RectifiedStitchedMosaic instances shall conform to Figure 2, Table 4, Table 5, and the XML schema being part of this standard.

Table 4 — Components of WCSEO::RectifiedStitchedMosaic structure

Name	Definition	Data type	Multiplicity
dataset	Reference to a Rectified Dataset referred to by the Stitched Mosaic on hand	WCSEO::DatasetReference	one or more (mandatory)

Table 5 — Components of WCSEO::DatasetReference structure

Name	Definition	Data type	Multiplicity
datasetId	Dataset referred to by the Stitched Mosaic on hand	WCS::CoverageId	one (mandatory)
contributingFootprint	Horizontal bounding polygon enclosing data areas of the Dataset contributing to the Stitched Mosaic on hand	EOP::Footprint	one (mandatory)

The Dataset references of an EO Coverage shall be consistent with the coverage’s EO Metadata references.

Requirement 14/req/ap-eo/composedOf-in-stitched-mosaic:

In WCSEO::ReferenceableStitchedMosaic and WCSEO::RectifiedStitchedMosaic instances with at least one eop:EarthObservation/eop:metaDataProperty/eop:EarthObservationMetaData/eop:composedOf the set of these elements shall be equal to the set of dataset identifiers of the Stitched Mosaic.

6.5.2 Spatio-temporal extent

A Stitched Mosaic is defined through a collection of spatially non-overlapping subsets of Datasets it refers to.

Requirement 15/req/ap-eo/contributingFootprint-inside-footprint:

For all Datasets *d* referred to by a Stitched Mosaic *s* the contributingFootprint associated with the reference to *d* shall be contained in the footprint of *d*.

Note The contributingFootprint may be identical to the footprint of a referred dataset which naturally fulfills the above requirement.

Requirement 16 /req/ap-eo/contirbutinFootprint-pairwise-disjoint:

For all Datasets d_1 and d_2 referred to by a Stitched Mosaic s the contributingFootprints associated with the reference to d_1 and d_2 **shall** be pair-wise disjoint.

Requirement 17 /req/ap-eo/contributingFootprint-union-of-footprints:

The footprint of a Stitched Mosaic **shall** be given by the union of the contributingFootprints of the Datasets the Stitched Mosaic refers to.

Requirement 18 /req/ap-eo/dataset-domain-set-in-stitched-mosaic-domain-set:

For all Datasets d referred to by a Stitched Mosaic s , all cells of d as defined by the domain set of d **shall** be included in the set of cells of s as defined by the domain set of s .

Datasets referred to by a Stitched Mosaic shall have aligned cell locations:

- In case of Rectified EO Coverages, Datasets of a Stitched Mosaics shall have the same resolution.

Requirement 19 /req/ap-eo/datasets-in-rectifiedStitcheMosaic-same-offsetVector:

All Datasets referred to by a Rectified Stitched Mosaic **shall** have identical values in the `gml:offsetVector` elements of their domain sets.

Requirement 20 /req/ap-eo/rectifiedStitchedMosaic-offsetVector:

In a Rectified Stitched Mosaic instance, the value of the `gml:offsetVector` elements of the domain set **shall** be given by the corresponding values of the Rectified Datasets the Rectified Stitched Mosaic refers to.

- In case of Referenceable EO Coverages, Datasets of Stitched Mosaics shall have aligned cell locations in overlapping areas.

Requirement 21 /req/ap-eo/referenceableStitchedMosaic-domain-set:

For any pair d_1 and d_2 of Datasets referred to by a given Stitched Mosaic, the set of point locations in the geographic overlap of the d_1 and d_2 domain set **shall** be identical.

The temporal validity of Stitched Mosaics is defined by the temporal validities of the Datasets the Stitched Mosaic refers to.

Requirement 22 /req/ap-eo/temporal-validity-stitched-mosaic:

For any given Stitched Mosaic, its temporal validity given by its `eop:EarthObservation/om:phenomenonTime/gml:TimePeriod/gml:beginPosition` and `eop:EarthObservation/om:phenomenonTime/gml:TimePeriod/gml:endPosition` elements in `wcseo:EOMetadata` **shall** be defined as the minimal time interval containing the temporal validities of all Datasets the Stitched Mosaic refers to.

6.5.3 Range type

Stitched Mosaics and their Datasets share the same range type.

Requirement 23 /req/ap-eo/datasets-in-stitched-mosaic-same-range-type:/:

For all Datasets d some Stitched Mosaic s refers to the following **shall** hold: The range type of d is identical to the range type of s .

6.5.4 Range set

The content of a Stitched Mosaic is given by the Datasets it refers to; cells of a Stitched Mosaic with domain coordinates outside of any embedded Dataset's contributingFootprint carry nil values.

Requirement 24 /req/ap-eo/nil-values-in-stitched-mosaic:

If the domain set of a Stitched Mosaic contains locations which are not inside any contributingFootprint the Stitched Mosaic refers to then the nil value set of that Stitched Mosaic **shall** not be empty.

Requirement 25 /req/ap-eo/range-values-of-stitched-mosaic:

For a Stitched Mosaic s its range values of cells with location p , expressed in any of the CRSs supported by s , **shall** be given as follows:

- if p is located within the contributingFootprint of some Dataset d referred to by s then it is the range value of d at p ;
- if p is not located within the contributingFootprint of any Dataset d referred to by s then it is one of the range values contained in the nil value set of s .

6.6 Dataset Series

A *Dataset Series* is an identifiable, queryable collection of EO Coverages.

NOTE A Dataset referred to by a Stitched Mosaic referred to by a Dataset Series is not per se referred to by that Dataset Series. However, it is allowed that such a Dataset is also referred to by the enclosing Dataset Series.

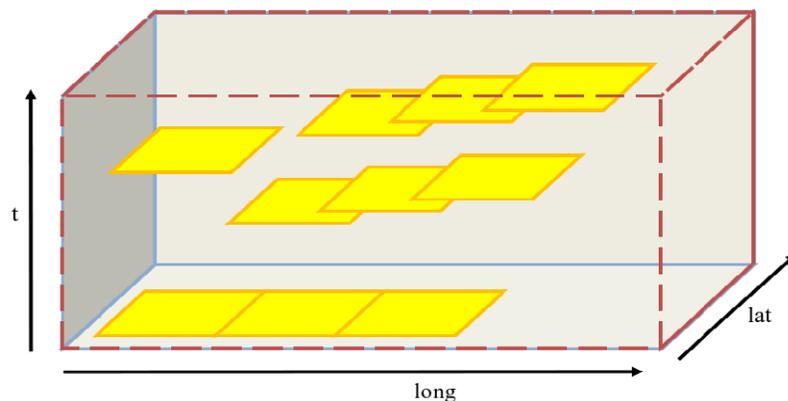


Figure 5 — Conceptual view of a Dataset Series referring to Datasets and Stitched Mosaics (Dataset Series domain boundary dashed)

Requirement 26 /req/ap-eo/datasetSeries-structure:

A `WCSEO::DatasetSeries` **shall** conform to Figure 2, Table 6, and the XML schema being part of this standard.

Table 6 — Components of `WCSEO::DatasetSeries` structure

Name	Definition	Data type	Multiplicity
datasetSeriesId	Identifier of the Dataset Series on hand	NCName	one (mandatory)
footprint	Horizontal bounding polygon enclosing valid data areas of the Dataset Series	EOP::Footprint	one (mandatory)
timePeriod	Temporal period of validity of all data in the Dataset Series	GML::TimePeriod	one (mandatory)
referenceable-StitchedMosaic	Referenceable Stitched Mosaic to which the Dataset Series on hand refers	WCS::CoverageId	zero or more (optional)
rectified-StitchedMosaic	Rectified Stitched Mosaic to which the Dataset Series on hand refers	WCS::CoverageId	zero or more (optional)
referenceable-Dataset	Referenceable Dataset to which the Dataset Series on hand refers	WCS::CoverageId	zero or more (optional)
rectifiedDataset	Rectified Dataset to which the Dataset Series on hand refers	WCS::CoverageId	zero or more (optional)

NOTE A Dataset Series and a Stitched Mosaic contained may therein both refer to the same Dataset.

The spatial extent of a Dataset Series shall enclose the spatial extents of all Stitched Mosaics and Datasets the Dataset Series refers to.

Requirement 27 /req/ap-eo/footprint-in-datasetSeries:

The `footprint` of a Dataset Series instance **shall** enclose the union of the footprints of all Stitched Mosaics and Datasets the Dataset Series refers to, expressed in WGS84.

NOTE As opposed to Stitched Mosaics, Dataset Series do not require disjointness of the EO Coverages they refer to.

The temporal validity of a Dataset Series is defined by the union of the temporal validities of all Stitched Mosaics and Datasets the Dataset Series refers to.

Requirement 28 /req/ap-eo/timePeriod-in-datasetSeries:

For any given Dataset Series, the `timePeriod` element **shall** enclose the temporal validities of all Stitched Mosaics and Datasets the Dataset Series refers to, expressed in ISO 8601 [2].

7 EO service model

7.1 Overview

This Clause defines request types and their responses for operations on EO Coverages. EO Coverages can be offered by a WCS server alongside with any other type of coverages. Behavior of the service on non-EO coverages remains unchanged.

7.2 *GetCapabilities* operation

7.2.1 *GetCapabilities* request

The *GetCapabilities* request is extended over WCS Core [OGC 09-110r3] as follows:

- In the `sections` request parameter, values “DatasetSeriesSummary” and “CoverageSummary” are allowed in addition to those defined in OWS Common [06-121r9].

Requirement 29 /req/ap-*eo*/getCapabilities-request-sections:

If a *GetCapabilities* request contains a `sections` element then this element **shall** contain `section` elements with the values defined in OWS Common, or “DatasetSeriesSummary”, or “CoverageSummary”.

Dependency: [OGC 06-121r9] clause 7.3.3

7.2.2 *GetCapabilities* response

The *GetCapabilities* response is extended over WCS Core [OGC 09-110r3] as follows:

- additional `DatasetSeriesSummary` section reporting Dataset Series identifiers;
- additional `CoverageSubtype` elements in `WCS::CoverageSummary` elements, reporting its parents in the inheritance hierarchy.

NOTE An EO-AP server may choose to not report, in the `CoverageSummary` section of a *GetCapabilities* response, the identifiers of Stitched Mosaic coverages referred to by some Dataset Series and the identifiers of Dataset coverages referred to by some Stitched Mosaic or Dataset Series.

In a *GetCapabilities* response, a server announces availability of this Earth Observation Application Profile like an extension.

Requirement 30 /req/ap-*eo*/getCapabilities-response-conformance-class-in-profile:

A WCS service implementing this extension shall include the following URI in a `Profile` element in the `ServiceIdentification` in a *GetCapabilities* response:

`http://www.opengis.net/spec/WCS_profile_earth-observation/1.0/conf/ap-eo`

Requirement 31 /req/ap-*eo*/getCapabilities-response-structure:

The response to a successful *GetCapabilities* request **shall** consist of a data structure as defined in Figure 5, Table 7, and the XML Schema being part of this standard.

Dependency: [OGC 09-110r3] Clause 8 (<http://www.opengis.net/doc/IS/WCS/2.0/clause/8>)

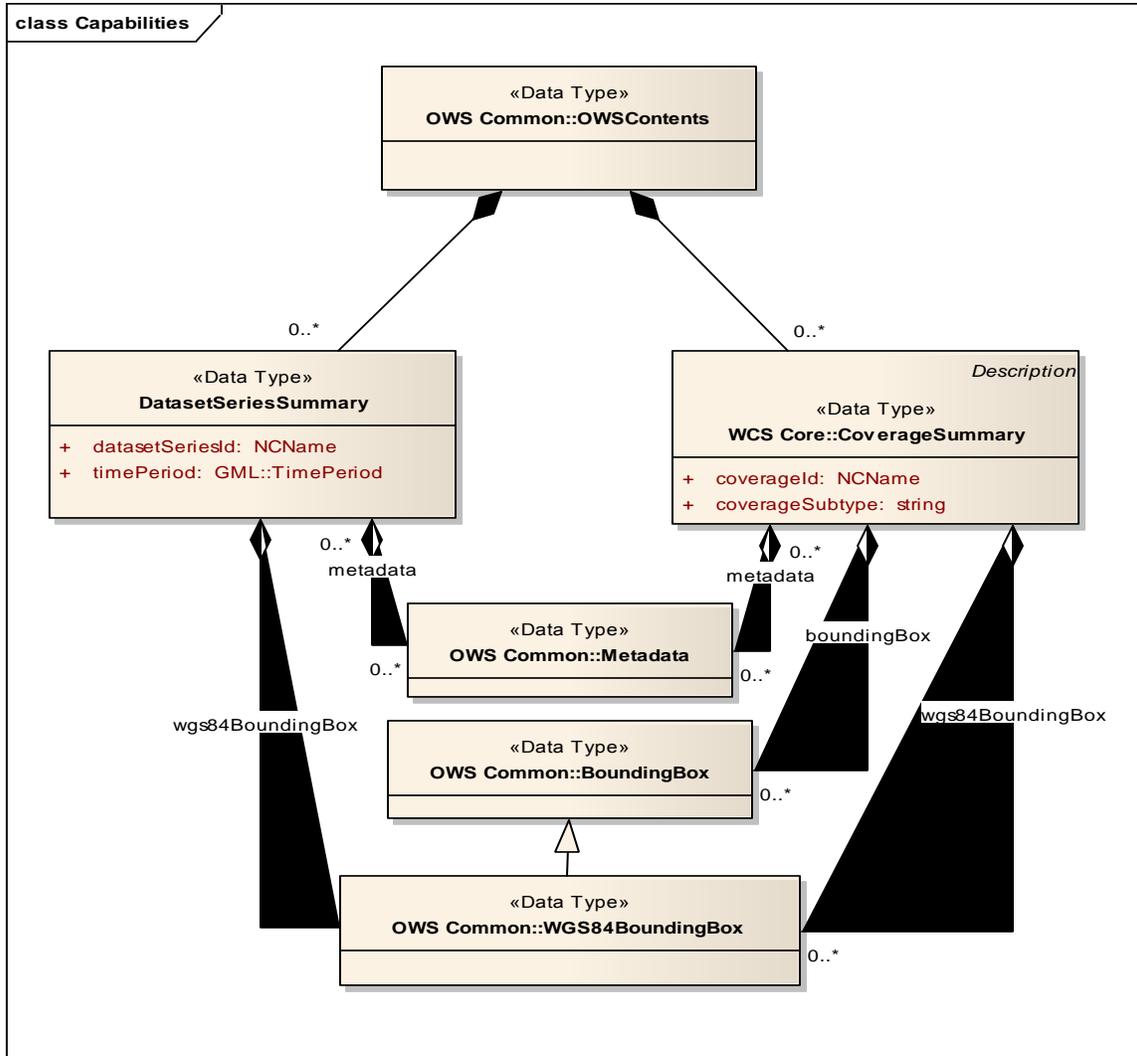


Figure 5 — *GetCapabilities* response UML class diagram

Table 7 — Components of WCSEO: :DatasetSeriesSummary structure

Name	Definition	Data type	Multiplicity
dataset-SeriesId	Identifier of a Dataset Series offered by this service	NCName	one (mandatory)
wgs84-Bounding-Box	Spatial extent of the Dataset Series	OWS Common::WGS84-BoundingBox	one (mandatory)
timePeriod	Time interval of validity of the Dataset Series	GML:TimePeriod	one (mandatory)
metadata	Reference to more metadata about this Dataset Series	OWS Common::Meta-data	zero or one (optional)

Requirement 32 /req/ap-eo/getCapabilities-response-datasetSeriesSummary:

In the response to a successful *GetCapabilities* request containing a `WCSEO::DatasetSeriesSummary` section, each Dataset Series identifier listed **shall** refer to a Dataset Series offered by the server.

Requirement 33 /req/ap-eo/getCapabilities-response-datasetSeriesSummary-no-duplicates:

A response to a successful *GetCapabilities* request containing a `WCSEO::DatasetSeriesSummary` section **shall** not contain any duplicate Dataset Series identifier.

Requirement 34 /req/ap-eo/getCapabilities-response-coverageSummary:

In the response to a successful *GetCapabilities* request containing an EO Coverage in a `WCS::CoverageSummary` section, each coverage identifier listed as EO Coverage **shall** refer to an EO Coverage offered by the server.

The response shall respect the `sections` request parameter.

Requirement 35 /req/ap-eo/getCapabilities-response-coverageSummary-section:

If a *GetCapabilities* request contains a `sections` parameter then a successful response **shall** contain `wcs:CoverageSummary` elements if and only if the section parameter list contains one of the values “CoverageSummary”, “Contents”, or “All”.

Requirement 36 /req/ap-eo/getCapabilities-response-datasetSeriesSummary-section:

If a *GetCapabilities* request contains a `sections` parameter then a successful response **shall** contain a `wcseo:DatasetSeriesSummary` elements if and only if the section parameter list contains one of the values “DatasetSeriesSummary” or “All”.

The coverage subtype shall indicate the specific type of the coverage returned, in case of an EO coverage.

Requirement 37 /req/ap-eo/getCapabilities-response-coverageSubtype:

In the response to a successful *GetCapabilities* request, each EO Coverage listed **shall** contain at least one `WCS::CoverageSubtype` element.

Requirement 38 /req/ap-eo/getCapabilities-response-coverageSubtype-hierarchy:

In the response to a successful *GetCapabilities*, in each EO Coverage reported and for each UML specialization step (each GML `substitutionGroup` step) in the type definition of this EO coverage there **shall** be exactly one `WCS::CoverageSubtype` element containing the coverage type of this step, in the exact sequence of these steps in the specification.

The CoverageSubtype values are summarized in Table 8 below.

Table 8 — Values of CoverageSubtype elements in CoverageDescription of EO coverages

Type of coverage identified by CoverageIdentifier	CoverageSubtype value
---	-----------------------

WCSEO::RectifiedDataset	RectifiedEOCoverage RectifiedDataset
WCSEO::ReferenceableDataset	ReferenceableEOCoverage ReferenceableDataset
WCSEO::RectifiedStitchedMosaic	RectifiedEOCoverae RectifiedStitchedMosaic
WCSEO::ReferenceableStitchedMosaic	ReferenceableEOCoverage ReferenceableStitchedMosaic

Example The following XML excerpt shows a possible Contents section containing Dataset Series information:

```
<wcs:Contents>
  <wcs:CoverageSummary>
    <wcs:CoverageId>someCoverage</wcs:CoverageId>
    <wcs:CoverageSubtype>RectifiedGridCoverage</wcs:CoverageSubtype>
    <wcs:CoverageSubtype>RectifiedEOCoverage</wcs:CoverageSubtype>
    <wcs:CoverageSubtype>RectifiedDataset</wcs:CoverageSubtype>
  </wcs:CoverageSummary>
  <wcseo:DatasetSeriesSummary>
    <ows:WGS84BoundingBox>
      <ows:LowerCorner>-180 -90</ows:LowerCorner>
      <ows:UpperCorner>180 90</ows:UpperCorner>
    </ows:WGS84BoundingBox>
    <wcseo:DatasetSeriesId>someDatasetSeries</wcseo:DatasetSeriesId>
    <gml:TimePeriod gml:id="someDatasetSeries_timeperiod">
      <gml:beginPosition>2010-01-01T00:00:00.000</gml:beginPosition>
      <gml:endPosition>2010-12-31T23:59:59.999</gml:endPosition>
    </gml:TimePeriod>
  </wcseo:DatasetSeriesSummary>
</wcs:Contents>
```

7.3 DescribeCoverage operation

7.3.1 DescribeCoverage request

The *DescribeCoverage* request is unchanged over WCS Core [OGC 09-110r3]. In particular, identifiers of EO Coverages can be passed as input parameters.

NOTE A *DescribeCoverage* request is possible on the identifiers of EO Coverages offered by the server even if these are not listed in a *GetCapabilities* response.

7.3.2 DescribeCoverage response

In a *DescribeCoverage* response, EO Coverage descriptions additionally contain the EO Metadata record.

Requirement 39 /req/ap-eo/describeCoverage-response-EO-metadata:

In the response to a successful *DescribeCoverage* request on an EO Coverage, one WCS-EO::EOMetadata element **shall** be present containing the EO Metadata component of the coverage addressed.

The coverage subtype shall indicate the specific type of the coverage returned, in case of an EO coverage.

Requirement 40 /req/ap-eo/describeCoverage-response-coverageSubtype:

In the response to a successful *DescribeCoverage* request addressing an EO Coverage, each EO Coverage listed **shall** include at least one WCS::CoverageSubtype element.

Requirement 41 /req/ap-eo/describeCoverage-response-coverageSubtype-hierarchy:

In the response to a successful *DescribeCoverage* request on an EO Coverage, for each UML specialization step (each GML substitutionGroup step) in the type definition of the EO coverage returned there **shall** be exactly one WCS::CoverageSubtype element containing the coverage type of this step, in the exact sequence of these steps in the specification.

The CoverageSubtype values are summarized in Table 8 above.

Example The following XML fragment shows parts of a possible *DescribeCoverage* response on an EO Coverage:

```
<wcs:CoverageDescriptions>
  <wcs:CoverageDescription gml:id="c1">
    <gml:boundedBy>
      <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSG/0/4326"
        axisLabels="Lat Long" srsDimension="2" uomLabels="deg deg">
        <gml:lowerCorner>42.862778 1.896944</gml:lowerCorner>
        <gml:upperCorner>43.516667 2.861667</gml:upperCorner>
      </gml:Envelope>
    </gml:boundedBy>
    <wcs:CoverageId>c1</wcs:CoverageId>
    <gmlcov:metadata>
      <wcseo:EOMetadata>
        <eop:EarthObservation gml:id="c1_metadata">
          <om:phenomenonTime>
            <gml:TimePeriod gml:id="c1_tp">
              <gml:beginPosition>2008-03-13T10:00:06.000</gml:beginPosition>
              <gml:endPosition>2008-03-13T10:20:26.000</gml:endPosition>
            </gml:TimePeriod>
          </om:phenomenonTime>
          <om:resultTime>
            <gml:TimeInstant gml:id="c1_archivingdate">
              <gml:timePosition>2001-08-22T11:02:47.999</gml:timePosition>
            </gml:TimeInstant>
          </om:resultTime>
          <om:procedure/>
          <om:observedProperty/>
          <om:featureOfInterest>
```

```

    <eop:Footprint gml:id="c1_fp">
      <eop:multiExtentOf>
        <gml:MultiSurface gml:id="c1_ms" srsName="EPSG:4326">
          <gml:surfaceMembers>
            <gml:Polygon gml:id="c1_fppoly">
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList>
                    43.516667 2.1025 43.381667 2.861667 42.862778 2.65
                    42.996389 1.896944 43.516667 2.1025
                  </gml:posList>
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
          </gml:surfaceMembers>
        </gml:MultiSurface>
      </eop:multiExtentOf>
      <eop:centerOf>
        <gml:Point gml:id="c1_p" srsName="EPSG:4326">
          <gml:pos>43.190833 2.374167</gml:pos>
        </gml:Point>
      </eop:centerOf>
    </eop:Footprint>
  </om:featureOfInterest>
</om:result/>
  <eop:metaDataProperty>
    <eop:EarthObservationMetaData>
      <eop:identifier>c1</eop:identifier>
      <eop:acquisitionType>NOMINAL</eop:acquisitionType>
      <eop:status>ARCHIVED</eop:status>
    </eop:EarthObservationMetaData>
  </eop:metaDataProperty>
</eop:EarthObservation>
  <lineage/>
</wcseo:EOMetadata>
<gmlcov:metadata>
<gml:domainSet>
  <gml:RectifiedGrid dimension="2"
    gml:id="c1_grid">
    ...
  </gml:RectifiedGrid>
</gml:domainSet>
<gmlcov:rangeType>
  ...
</gmlcov:rangeType>
<wcs:ServiceParameters>
  <wcs:CoverageSubtype>RectifiedGridCoverage</wcs:CoverageSubtype>
  <wcs:CoverageSubtype>RectifiedEOCoverage</wcs:CoverageSubtype>
  <wcs:CoverageSubtype>RectifiedDataset</wcs:CoverageSubtype>
</wcs:ServiceParameters>

```

```
</wcs:CoverageDescription>
</wcs:CoverageDescriptions>
```

NOTE The complete example is provided with the schema files being part of this standard.

7.4 *GetCoverage* operation

7.4.1 *GetCoverage* request

The *GetCoverage* request is unchanged over WCS Core [OGC 09-110r3], except that for EO Coverages slicing is disallowed as it would leave the EO Metadata undefined.

NOTE A *GetCoverage* request is possible on the identifiers of EO Coverages offered by the server even if these are not listed in a *GetCapabilities* response.

Requirement 42/req/ap-eo/getCoverage-request-no-slicing:

A *GetCoverage* request on EO Coverages **shall** not contain a slicing operation.

7.4.2 *GetCoverage* response

The *GetCoverage* response is as defined in the WCS Core [OGC 09-110-r3], however extended in two respects:

- The coverage returned contains exactly one metadata element holding the EO Metadata record (it may contain further metadata elements in addition);
- The lineage component of the EO Metadata record returned consists of the pre-existing lineage sequence plus one element appended which describes the *GetCoverage* request on hand.

NOTE As always, whether all these elements will be available to a client depends on the degree of support for the information items by the requested coverage encoding.

On EO Coverages, a *GetCoverage* request shall produce a coverage of the type corresponding to the coverage inspected.

Requirement 43/req/ap-eo/getCoverager-response-rectified-grid-coverage:

The response to a successful *GetCoverage* request on a Rectified Stitched Mosaic or a Rectified Dataset **shall** be of type Rectified Grid Coverage.

Requirement 44/req/ap-eo/getCoverager-response-referenceable-grid-coverage:

The response to a successful *GetCoverage* request on a Referenceable Stitched Mosaic or a Referenceable Dataset **shall** be of type Referenceable Grid Coverage.

The EO Metadata, including the extended lineage record, shall be delivered alongside with the coverage data, adjusted according to the operations executed during *GetCoverage* evaluation.

Requirement 45/req/ap-eo/getCoverager-response-eo-metedata:

In the response to a successful *GetCoverage* request on an EO Coverage, the `WCSEO::EO-Metadata` of the coverage returned **shall** contain the complete `WCSEO::EOMetadata` of

the coverage addressed, adjusted as specified in Requirement 46, Requirement 47, and Requirement 48.

Requirement 46 /req/ap-eo/getCoverager-response-EO-metadata-in-stitched-mosaic:

In the response to a successful *GetCoverage* request on a Stitched Mosaic, the `WCSEO::EO-Metadata` of the coverage returned **shall** contain the original Stitched Mosaic's references to those Datasets which have a non-empty intersection with the effective spatio-temporal request trim interval, and no other ones.

Requirement 47 /req/ap-EO/getCoverager-response-footprint-in-EO-metadata:

If, in a successful *GetCoverage* request on an EO Coverage, trimming along spatial coordinates is specified then the footprint of the `WCSEO::EOMetadata` in the coverage returned **shall** be given by the intersection of the spatial request interval and the footprint of the coverage requested. Otherwise, the footprint in the result coverage **shall** be given by the footprint of the coverage requested.

The lineage record shall be extended by a reproducible description of the *GetCoverage* request originating this output.

Requirement 48 /req/ap-EO/getCoverager-response-lineage-in-EO-metadata:

In the response to a successful *GetCoverage* request, the Lineage component **shall** consist of the Lineage component of the coverage requested with one record appended containing the complete *GetCoverage* request leading to this response.

Example The following XML fragment shows parts of a possible *GetCoverage* response on an EO Coverage:

```
<gmlcov:RectifiedGridCoverage
  xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
  xmlns:swe="http://www.opengis.net/swe/2.0"
  xmlns:wcs="http://www.opengis.net/wcs/2.0"
  xmlns:wcseo="http://www.opengis.net/wcseo/1.0"
  xmlns:eop="http://www.opengis.net/eop/2.0"
  xmlns:om="http://www.opengis.net/om/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wcseo/1.0
    http://schemas.opengis.net/wcseo/1.0/wcsEOGetCoverage.xsd"
  gml:id="c1">
  <gml:boundedBy>
  ...
  </gml:boundedBy>
  <gml:domainSet>
  ...
  </gml:domainSet>
  <gml:rangeSet>
  ...
  </gml:rangeSet>
```

```

<gmlcov:rangeType>
...
</gmlcov:rangeType>
<gmlcov:metadata>
  <wcseo:EOMetadata>
    <eop:EarthObservation gml:id="c1_metadata">
      <om:phenomenonTime>
        <gml:TimePeriod gml:id="c1_tp">
          <gml:beginPosition>2008-03-13T10:00:06.000</gml:beginPosition>
          <gml:endPosition>2008-03-13T10:20:26.000</gml:endPosition>
        </gml:TimePeriod>
      </om:phenomenonTime>
      <om:resultTime>
        <gml:TimeInstant gml:id="c1_archivingdate">
          <gml:timePosition>2001-08-22T11:02:47.999</gml:timePosition>
        </gml:TimeInstant>
      </om:resultTime>
      <om:procedure>
        ...
      </om:procedure>
      <om:observedProperty xlink:href="#phenom1"></om:observedProperty>
      <om:featureOfInterest>
        ...
      </om:featureOfInterest>
      <om:result>
        ...
      </om:result>
      <eop:metaDataProperty>
        ...
      </eop:metaDataProperty>
    </eop:EarthObservation>
    <wcseo:lineage><![CDATA[GetCoverage request:
http://www.someWCS.org?SERVICE=WCS&VERSION=2.0.0&REQUEST=GetCoverage
&FORMAT=application/gml+xml]]></wcseo:lineage>
  </wcseo:EOMetadata>
</gmlcov:metadata>
</gmlcov:RectifiedGridCoverage>

```

7.5 DescribeEOCoverageSet operation

7.5.1 Overview

A *DescribeEOCoverageSet* request submits a Dataset Series, Stitched Mosaic, or Dataset identifier together with a spatio-temporal subsetting criterion (“bounding box”). The spatial constraint is expressed in WGS84 [4], the temporal constraint in ISO 8601 [2].

The response to a successful request on a Dataset Series consists of a (possibly empty) set of descriptions of Datasets and Stitched Mosaics and a (possibly empty) set of descriptions of Dataset Series. The response to a successful request on a Stitched Mosaic consists of a (possibly empty) set of descriptions of Datasets. In any case, the result items are those ones which

are (i) referred to by the object submitted and (ii) matched by the bounding box. The type of matching – contains or overlaps – is specified in the request.

7.5.2 DescribeEOCoverageSet request

Requirement 49 /req/ap-eo/describeEOCoverageSet-request-structure:
 A *DescribeEOCoverageSet* request shall consist of a structure as defined in Figure 6 and Table 9.

The *DescribeEOCoverageSet* request type contains two sections (cf. [OGC 06-121r9] Clause 7.3.3) whose appearance in the response can be controlled by the client through the optional sections parameter.

Requirement 50 /req/ap-eo/describeEOCoverageSet-request-sections:
 If a *DescribeEOCoverageSet* request contains a sections element then this element shall contain values one of the values “CoverageDescriptions”, “DatasetSeriesDescriptions”, or “All”.

Dependency: [OGC 06-121r9] clause 7.3.3

NOTE This use of the sections parameters is similar to its use in *GetCapabilities* as defined in OWS Common [OGC 06-121r9].

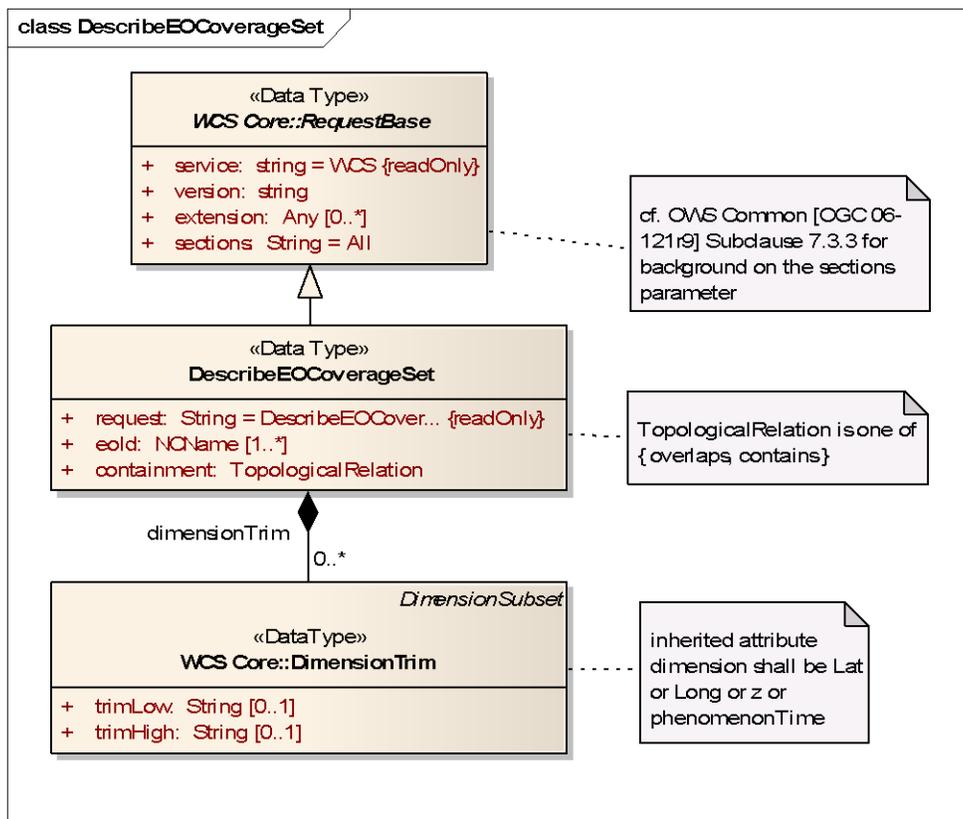


Figure 6 — DescribeEOCoverageSet request UML diagram

Table 9 — Components of DescribeEOCoverageSet operation request

Name	Definition	Data type	Multiplicity
request	Request name	String, fixed to "DescribeEOCoverageSet"	one (mandatory)
eoId	Identifier of Dataset Series or EO Coverage evaluated	NCName	one or more (mandatory)
containment	Intersection mode for evaluation of object bounding box against request parameters	String	zero or one (optional)
sections	Unordered list of zero or more names of the XML elements that shall be returned	String	zero or one (optional)
dimension-Trim	trim specification, as per WCS Core [OGC 09-110r3] Subclause 8.4.1	WCS::DimensionTrim	zero or more (optional)

NOTE Future versions of the EO-AP are likely to use the `DimensionTrim` element defined in the forthcoming *Predefined CRSs Extension* instead of `WCS::DimensionTrim`.

Requirement 51/req/ap-eo/describeEOCoverageSet-request-eoId:

The `eoId` parameter value in a *DescribeEOCoverageSet* request **shall** be equal to the identifier of a Dataset, a Stitched Mosaic, or a Dataset Series offered by the server addressed.

NOTE A *DescribeEOCoverageSet* request is possible on the identifiers of objects offered by the server even if these are not listed in a *GetCapabilities* response.

Requirement 52/req/ap-eo/describeEOCoverageSet-request-containment:

If a *DescribeEOCoverageSet* request contains a `containment` parameter then this parameter **shall** have one of the values "contains" or "overlaps".

Requirement 53/req/ap-eo/describeEOCoverageSet-request-dimensions:

If a *DescribeEOCoverageSet* request contains `dimensionTrim` elements with `dimension` parameters then each such `dimension` parameter **shall** have one of the values "Lat", "Long", or "phenomenonTime", Each of these values shall appear at most once in a given request.

Requirement 54/req/ap-eo/describeEOCoverageSet-request-crs:

A *DescribeEOCoverageSet* request **shall** use WGS84 [4] as spatial and ISO 8601 [2] as temporal CRS for the coordinates in trim requests.

NOTE Trim coordinates are not required to lie within the boundaries of the EO Coverage inquired.

Example The following XML instance shows a possible *DescribeEOCoverageSet* operation request:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<wcseo:DescribeEOCoverageSet
  xmlns:wcseo="http://www.opengis.net/wcseo/1.0"
  xmlns:wcs="http://www.opengis.net/wcs/2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
```

```

xsi:schemaLocation="http://www.opengis.net/wcseo/1.0
  http://schemas.opengis.net/wcseo/1.0/wcsEOAll.xsd"
service="WCS" version="2.0.0">
<wcseo:eoId>DS1</wcseo:eoId>
<wcseo:containment>overlaps</wcseo:containment>
<wcseo:sections>
  <wcseo:section>All</wcseo:section>
</wcseo:sections>
<wcs:DimensionTrim>
  <wcs:Dimension>Long</wcs:Dimension>
  <wcs:TrimLow>16</wcs:TrimLow>
  <wcs:TrimHigh>18</wcs:TrimHigh>
</wcs:DimensionTrim>
<wcs:DimensionTrim>
  <wcs:Dimension>Lat</wcs:Dimension>
  <wcs:TrimLow>46</wcs:TrimLow>
  <wcs:TrimHigh>48</wcs:TrimHigh>
</wcs:DimensionTrim>
<wcs:DimensionTrim>
  <wcs:Dimension>phenomenonTime</wcs:Dimension>
  <wcs:TrimLow>2011-01-18T22:21:52Z</wcs:TrimLow>
  <wcs:TrimHigh>2011-01-18T22:22:52Z</wcs:TrimHigh>
</wcs:DimensionTrim>
</wcseo:DescribeEOCoverageSet>

```

7.5.3 *DescribeEOCoverageSet* response

The response to a successful *DescribeEOCoverageSet* request consists of a (possibly empty) set of EO Coverage descriptions and a (possibly empty) set of Dataset Series descriptions.

Requirement 55 /req/ap-eo/describeEOCoverageSet-response-structure:

The response to a successful *DescribeEOCoverageSet* request **shall** consist of a WCS-EO::EOCoverageSetDescription structure.

Dependency: [OGC 09-110r3] Subclause 8.3.2

(<http://www.opengis.net/doc/IS/WCS/2.0/clause/8>)

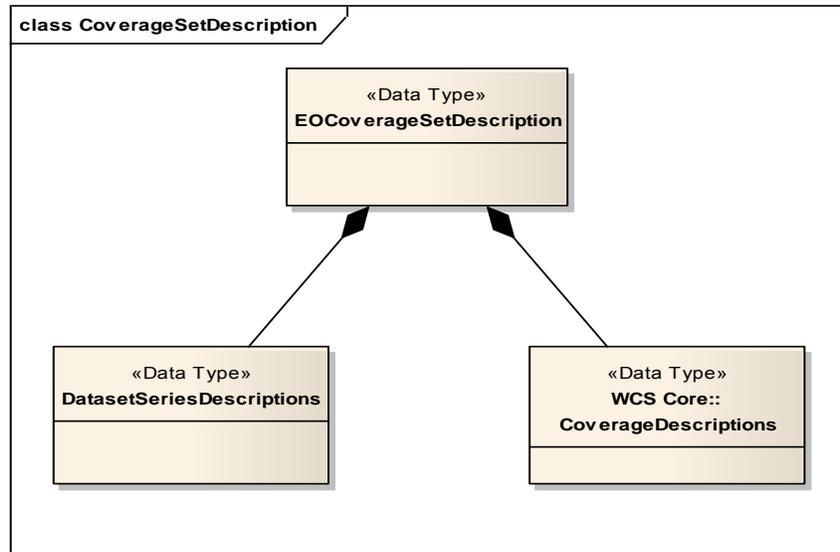


Figure 7 — *DescribeEOCoverageSet* response UML diagram

Requirement 56/req/ap-eo/describeEOCoverageSet-response-eo-metadata:

Each `WCS::CoverageDescription` listed in the response to a successful *DescribeEOCoverageSet* request **shall** contain one `WCSEO::EOMetadata` element containing the EO Metadata component of the EO Coverage to be described.

The response shall respect the `sections` request parameter.

Requirement 57/req/ap-eo/describeEOCoverageSet-response-section-coverageDescriptions:

If a *DescribeEOCoverageSet* request contains a `sections` parameter then a successful response **shall** contain a `wcs:CoverageDescriptions` element if and only if the section parameter list contains one of the values “CoverageDescriptions” or “All”.

Requirement 58/req/ap-eo/describeEOCoverageSet-response-section-datasetSeriesDescriptions:

If a *DescribeEOCoverageSet* request contains a `sections` parameter then a successful response **shall** contain a `wcseo:DatasetSeriesDescriptions` element if and only if the section parameter list contains one of the values “DatasetSeriesDescriptions” or “All”.

Such a response contains only EO coverages referred to by the object(s) addressed in the request.

Requirement 59/req/ap-eo/describeEOCoverageSet-response-eoId:

In the response to a successful *DescribeEOCoverageSet* request containing a `wcs:CoverageDescription` section, each EO coverage referred to by one of the objects identified in the `eoId` request parameter **shall** appear at most once.

Spatial subsetting is evaluated against the `eop:Footprint` element contained in the `EOMetadata` element of an EO coverage.

Requirement 60/req/ap-eo/describeEOCoverageSet-response-containment:

The response to a successful *DescribeEOCoverageSet* request containing a `wcs:CoverageDescription` section **shall** contain only descriptions of those EO Coverages whose spatial footprint defined by its `eop:EarthObservation/om:featureOfInterest/eop:Footprint`

- overlaps with the spatial request extent, in case request parameter `containment` is of value `OVERLAPS` or is omitted,
- is completely contained within the spatial request extent, in case request parameter `containment` is of value `CONTAINS`

whereby all spatial coordinates are expressed in WGS84 [2].

Temporal subsetting is evaluated against the temporal validity of an EO coverage.

Requirement 61/req/ap-eo/describeEOCoverageSet-response-phenomenonTime:

The response to a successful *DescribeEOCoverageSet* request containing a `wcs:CoverageDescription` section **shall** contain only descriptions of EO Coverages whose time interval defined by its `eop:EarthObservation/om:phenomenonTime/gml:TimePeriod/gml:beginPosition` and `eop:EarthObservation/om:phenomenonTime/gml:TimePeriod/gml:endPosition` elements in `wcs-eo:EOMetadata`

- overlaps with the request time extent, in case request parameter `containment` is of value `OVERLAPS` or is omitted,
- is completely contained within the request time extent, in case request parameter `containment` is of value `CONTAINS`,

whereby all temporal coordinates are expressed in ISO 8601 [2].

Boundary values omitted are substituted by the actual boundary value of the object inquired.

Requirement 62/req/ap-eo/describeEOCoverageSet-response-trim-omitted:

In a *DescribeEOCoverageSet* request, a trim specification omitted **shall** be interpreted as the actual boundary of the objects requested in the axis omitted.

Requirement 63/req/ap-eo/describeEOCoverageSet-response-bound-omitted:

In a *DescribeEOCoverageSet* request, a lower or upper bound omitted **shall** be interpreted as indicating the actual lower or upper bound of the objects requested in the axis omitted.

NOTE This trim semantics is analogous to trimming in *GetCoverage*.

Requirement 64/req/ap-eo/describeEOCoverageSet-response-coverageSubtype:

In the response to a successful *DescribeEOCoverageSet* request, each EO Coverage listed **shall** include at least one `WCS::CoverageSubtype` element.

Requirement 65/req/ap-eo/describeEOCoverageSet-response-coverageSubtype-hierarchy:

In the response to a successful *DescribeEOCoverageSet* request for each EO Coverage, for each UML specialization step (each GML `substitutionGroup` step) in the type definition of the EO coverage returned there **shall** be exactly one `WCS::CoverageSubtype` element containing the coverage type of this step, in the exact sequence of these steps in the specification.

The CoverageSubtype values are summarized in Table 8 above.

Example The following XML fragment shows parts of a possible DescribeEOCoverageSet operation response:

```

<wcseo:EOCoverageSetDescription>
  <wcs:CoverageDescriptions>
    <wcs:CoverageDescription gml:id="c1">
      <gml:boundedBy>
        ...
      </gml:boundedBy>
      <wcs:CoverageId>c1</wcs:CoverageId>
      <gmlcov:metadata>
        <wcseo:EOMetadata>
          <eop:EarthObservation gml:id="c1_metadata">
            ...
          </eop:EarthObservation>
        </wcseo:EOMetadata>
      </gmlcov:metadata>
      <gml:domainSet>
        ...
      </gml:domainSet>
      <gmlcov:rangeType>
        ...
      </gmlcov:rangeType>
      <wcs:ServiceParameters>
        <wcs:CoverageSubtype>RectifiedGridCoverage</wcs:CoverageSubtype>
        <wcs:CoverageSubtype>RectifiedEOCoverage</wcs:CoverageSubtype>
        <wcs:CoverageSubtype>RectifiedStitchedMosaic</wcs:CoverageSubtype>
        <wcseo:dataset>
          <wcs:CoverageId>c3</wcs:CoverageId>
        </wcseo:dataset>
      </wcs:ServiceParameters>
    </wcs:CoverageDescription>
  </wcs:CoverageDescriptions>
  <wcseo:DatasetSeriesDescriptions>
    <wcseo:DatasetSeriesDescription gml:id="ds2">
      <gml:boundedBy>
        <gml:Envelope axisLabels="Lat Long" srsDimension="2"
          srsName="http://www.opengis.net/def/crs/EPSSG/0/4326" uomLabels="deg deg">
          <gml:lowerCorner>46 16</gml:lowerCorner>
          <gml:upperCorner>48 18</gml:upperCorner>
        </gml:Envelope>
      </gml:boundedBy>
      <wcseo:DatasetSeriesId>ds2</wcseo:DatasetSeriesId>
      <gml:TimePeriod gml:id="ds2_timeperiod">
        <gml:beginPosition>2010-01-01T00:00:00.000</gml:beginPosition>
        <gml:endPosition>2010-12-31T23:59:59.999</gml:endPosition>
      </gml:TimePeriod>
    </wcseo:DatasetSeriesDescription>
  </wcseo:DatasetSeriesDescriptions>
</wcseo:EOCoverageSetDescription>

```

</wcseo:DatasetSeriesDescriptions>
</wcseo:EOCoverageSetDescription>

7.5.4 DescribeEOCoverageSet exceptions

Table 10— Exception codes for DescribeEOCoverageSet operation

exceptionCode value	HTTP code	Meaning of exception code	locator value
NoSuch-DatasetSeries	404	The identifier passed does not match with any of the Dataset Series offered by this server	List of violating Dataset Series identifiers

8 WCS extensions

8.1 Band subsetting

Requirement 66 /req/ap-eo/band-subsetting:

Implementations of this Earth Observation Application Profile **shall** support the WCS 2.0 Band Subsetting Extension.

Dependency: http://www.opengis.net/spec/WCS_service-model_band-subsetting/1.0/conf/band-subsetting

8.2 Scaling & interpolation

Requirement 67 /req/ap-eo/scaling+interpolation:

Implementations of this Earth Observation Application Profile **shall** support the WCS 2.0 Scaling & Interpolation Extension.

Dependency: http://www.opengis.net/spec/WCS_service-model_scaling+interpolation/1.0/conf/scaling+interpolation

8.3 CRSs

Requirement 68 /req/ap-eo/crs-predefined:

Implementations of this Earth Observation Application Profile **shall** support the WCS 2.0 Predefined CRS Extension.

Dependency: http://www.opengis.net/spec/WCS_service-model_crs-predefined/1.0/conf/crs-predefined

8.4 Coverage format encodings

Requirement 69 /req/ap-eo/encodings:

Implementations of this Earth Observation Application Profile **shall** support at least one of the WCS 2.0 coverage format encodings GeoTIFF, NetCDF, and JPEG2000.

Dependency: http://www.opengis.net/spec/WCS_encoding_geotiff/1.0/conf/geotiff,
http://www.opengis.net/spec/WCS_encoding_netcdf/1.0/conf/netcdf,
http://www.opengis.net/spec/WCS_encoding_jpeg2000/1.0/conf/jpeg2000

9 Protocol Bindings

9.1 Protocol choices

Requirement 70/req/ap-eo/protocol-bindings:

Implementations of this Earth Observation Application Profile **shall** support at least one of the conformance classes `ap-eo_get-kvp` or `ap-eo_soap`.

Dependency: http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/conf/ap-eo_get-kvp, http://www.opengis.net/spec/WCS_application-profile_earth-observation/1.0/conf/ap-eo_soap

9.2 GET-KVP protocol conformance class

9.2.1 WCS GET/KVP encoding

Requirement 71/req/ap-eo_get-kvp/core:

Implementations of this Earth Observation Application Profile which support the *get-kvp* conformance class **shall** support the WCS 2.0 protocol extension GET/KVP.

Dependency: http://www.opengis.net/spec/WCS_protocol-binding_get-kvp/1.0/conf/get-kvp

Requirement 72/req/ap-eo_get-kvp/conformance-class-in-profile:

Implementations of this Earth Observation Application Profile which support the *get-kvp* conformance class **shall** include the following URI in a `Profile` element in the `ServiceIdentification` in a *GetCapabilities* response:

```
http://www.opengis.net/spec/WCS_profile_earth-observation/1.0/conf/ap-eo_get-kvp
```

9.2.2 DescribeEOCoverageSet GET/KVP encoding

Requirement 73/req/ap-eo_get-kvp/describeEOCoverageSet-request:

The `request` parameter in the `DescribeEOCoverageSet` request parameter of a *DescribeEOCoverageSet* request **shall** be indicated as follows:

```
request=DescribeEOCoverageSet
```

Requirement 74/req/ap-eo_get-kvp/describeEOCoverageSet-eoid:

The `eoId` parameter in the `DescribeEOCoverageSet` request parameter of a *DescribeEOCoverageSet* request **shall** be indicated as follows, for parameter values v_1, \dots, v_n :

```
eoId= v1, ..., vn
```

Requirement 75/req/ap-eo_get-kvp/describeEOCoverageSet-containment:

The `containment` parameter in the `DescribeEOCoverageSet` request parameter of a *DescribeEOCoverageSet* request **shall** be indicated as follows:

```
containment=OVERLAPS
```

or `containment=CONTAINS`

Requirement 76/req/ap-eo_get-kvp/describeEOCoverageSet-subset:

The `trim` parameters in the `DescribeEOCoverageSet` request parameter of a *DescribeEOCoverageSet* request **shall** be indicated through a possibly empty set of subset specifications, each one with key “subset” and value specification given by a `SubsetSpec` adhering to this EBNF syntax [3] and the resp. XML definitions [6]:

```
SubsetSpec: dimension , crs ( interval )
```

```

dimension:  NCName
crs:        anyURI
interval:   low , high
low:        point | *
high:       point | *
point:      number | " token " // " = ASCII 0x42

```

Syntax rules follow the http standard [3]: underlined tokens represent literals which appear “as is” (“terminal symbols”), other tokens represent sub-expressions to be substituted (“non-terminals”). A vertical bar (“|”) denotes alternatives, items in brackets (“[]”) are optional. Non-terminals *NCName*, *number*, *token*, and *anyURI* follow the resp. XML definitions [6].

NOTE 1 Allowed values for points are determined by the CRS used. This ranges from “2009-11-06” for time to “-41.5” and “41°5’ ” for lat/long whereby non-numeric values have to be enclosed in double quotes.

NOTE 2 CRSs are fixed to WGS84 for space and ISO 8601 for time; still they need to be indicated in the request syntax to keep it in sync with WCS Core trimming.

NOTE 3 As per http [3], keys are case insensitive whereas values are case sensitive.

Example The following KVP-encoded *DescribeEOCoverageSet* request addresses service path on server `www.myserver.org` at port `port` retrieves coverage 42 in the domain specified by the bounding box with longitude (-71,47) and latitude (-66,51), expressed in spatial CRS WGS84-2D and temporal CRS ISO:8601 (which are assumed to be supported for the coverage):

```

http://www.myserver.org:port/path?
  service=WCS
  &version=1.0
  &request=DescribeEOCoverageSet
  &eoid=C0002
  &mode=OVERLAPS
  &subset=Long,http://www.opengis.net/def/crs/EPSG/0/4326(-71,47)
  &subset=Lat,http://www.opengis.net/def/crs/EPSG/0/4326(-66,51)
  &subset=phenomenonTime,http://www.opengis.net/def/trs/ISO-
  8601/0/Gregorian+UTC("2009-11-06T23:20:52Z","2009-11-
  13T23:20:52Z")

```

9.3 SOAP protocol conformance class

9.3.1 WCS SOAP encoding

Requirement 77/req/ap-*eo_soap*/core:

Implementations of this Earth Observation Application Profile which support the *soap* conformance class **shall** support the WCS 2.0 protocol extension SOAP.

Dependency: http://www.opengis.net/spec/WCS_protocol-binding_soap/1.0/conf/soap

Requirement 78/req/ap-*eo_soap*/conformance-class-in-profile:

Implementations of this Earth Observation Application Profile which support the *get-kvp* conformance class **shall** include the following URI in a *Profile* element in the *ServiceIdentification* in a *GetCapabilities* response:

```

http://www.opengis.net/spec/WCS_profile_earth-
observation/1.0/conf/ap-eo_soap

```

9.3.2 *DescribeEOCoverageSet* SOAP encoding

Requirement 79 /req/ap-*eo_soap*/describeEOCoverageSet-request-structure:

A *DescribeEOCoverageSet* request **shall** contain exactly one `Body` element containing exactly one `DescribeEOCoverageSet` element.

Requirement 80 /req/ap-*eo_soap*/describeEOCoverageSet-response-structure:

In the response to a successful *DescribeEOCoverageSet* request, the `SOAP Envelope` **shall** contain exactly one `Body` element which contains a `WCSEO::EOCoverageSetDescription` as its single element.

Example See files `wcseo_requestDescribeEOCoverageSet.xml` and `wcseo_responseDescribeEOCoverageSet.xml` being part of this standard.

9.3.3 *DescribeEOCoverageSet* WSDL

Requirement 81 /req/ap-*eo_soap*/wsdl:

Publication of a WCS SOAP service endpoint **shall** use the binding as defined in file `wSDL/wcs-soap-binding.wsdl` of the WCS EO-AP package.

NOTE A sample service description relying on this binding is provided in file `example-soap-endpoint.wsdl`.

Bibliography

- [1] OGC 09-153, *WCS 2.0 Overview: Core and Extensions*, version 1.0.0
- [2] ISO 8601:2004(E) *Data elements and interchange formats — Information interchange — Representation of dates and time*
- [3] IETF RFC 2616, *Hypertext Transfer Protocol -- HTTP/1.1*. IETF, 1999
- [4] www.epsg.org
- [5] W3C Note 11, *SOAP Messages with Attachments*. W3C Note 11, 2000
- [6] XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, 2004

Annex A (normative)

Abstract test suite

A WCS implementation must satisfy the following system characteristics to be conformant with this specification.

TODO:

update for recent changes in reqs;

re-establish field references in “test purpose”

numbering for a3 headers below

A.1 Conformance Test Class: ap-eo

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/WCS/2.0/conf/WCS_application-profile_ap-eo/1.0/conf/ap-eo.

Tests identifiers below are relative to

http://www.opengis.net/spec/WCS/2.0/WCS_application-profile_ap-eo/1.0/.

EO Metadata

Test id: `/conf/ap-eo/eo-metadata-structure`

Test Purpose: **Requirement /req/ap-eo/eo-metadata-structure:**

A `WCSEO::EOMetadata` instance **shall** conform to Table 2, Figure 2, and the XML schema being part of this standard.

Test method: For each EO Coverage offered by the server under test, retrieve coverage information via *DescribeCoverage*, *DescribeEOCoverageSet*, and *GetCoverage* operations. Check that the responses contain a `WCSEO::EOMetadata` corresponding to the definition and that all responses contain the same information. Test passes if all individual tests pass.

Footprint in EO Metadata

Test id: `/conf/ap-eo/footprint-in-eo-metadata`

Test Purpose: **Requirement /req/ap-eo/footprint-in-eo-metadata:**

The `WCSEO::EOMetadata` element of `WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** contain an `eop:Earth-Observation/om:featureOfInterest/eop:Footprint` element.

Test method: For each EO Coverage offered by the server under test, retrieve coverage information via *DescribeCoverage*, *DescribeEOCoverageSet*, and *GetCov-*

erage operations. Check that the responses contain an `eop:Earth-Observation/om:featureOfInterest/eop:Footprint` element in the `WCSEO::EOMetadata` and that all responses contain the same information. Test passes if all individual tests pass.

EO Coverage

Test id: `/conf/ap-eo/eo-coverage-structure`

Test Purpose: **Requirement /req/ap-eo/eo-coverage-structure**
`WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** conform to Figure 2 and the XML schema being part of this standard.

Test method: -

EO Metadata in EO Coverage

Test id: `/conf/ap-eo/eo-metadata-in-eo-coverage`

Test Purpose: **Requirement /req/ap-eo/eo-metadata-in-eo-coverage:**
`WCSEO::ReferenceableEOCoverage` and `WCSEO::RectifiedEOCoverage` instances **shall** contain one metadata element of type `WCSEO::EOMetadata`.

Test method: For each EO Coverage offered by the server under test, retrieve coverage information via *DescribeCoverage*, *DescribeEOCoverageSet*, and *GetCoverage* operations. Check that the responses contain a `WCSEO::EOMetadata` and that all responses contain the same information. Test passes if all individual tests pass.

Dataset: ReferenceableDataset

Test id: `/conf/WCS_profile_earth-observation/1.0/req2`

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/req2:**
A `WCSEO::ReferenceableDataset` **shall** conform with Figure 2 and the XML schema being part of this standard.

Test method: For each `WCSEO::ReferenceableDataset` offered by the server under test, send a *GetCoverage* request to server under test, check the result consists of an XML document of type `WCSEO::ReferenceableDataset` as described in the references stated by the requirement. Test passes if all individual tests pass.

Dataset: RectifiedDataset

Test id: `/conf/WCS_profile_earth-observation/1.0/req3`

- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/req3:**
A `WCSEO::RectifiedDataset` **shall** conform with Figure 2 and the XML schema being part of this standard.
- Test method:** For each `WCSEO::RectifiedDataset` offered by the server under test, send a *GetCoverage* request to server under test, check the result consists of an XML document of type `WCSEO::RectifiedDataset` as described in the references stated by the requirement. Test passes if all individual tests pass.

Dataset: `srs`

Test id: `/conf/WCS_profile_earth-observation/1.0/req4`

- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/req4:**
In a `WCSEO::ReferenceableDataset` or `WCSEO::RectifiedDataset`, the `srsName` attribute in the `gml:Envelope` in `gml:boundedBy` **shall** contain the axis labels „Lat” and „Long”, and no other axis labels.
- Test method:** For each `WCSEO::ReferenceableDataset` or `WCSEO::RectifiedDataset` offered by the server under test, send both *DescribeCoverage* and *GetCoverage* request to server under test, and verify that the `srsName` attribute in the `gml:Envelope` in `gml:boundedBy` contain the axis labels only „Lat” and „Long”, and is the same in both responses. Test passes if all individual tests. Test passes if all individual tests pass.

Stitched Mosaic: `ReferenceableStitchedMosaic`

Test id: `/conf/WCS_profile_earth-observation/1.0/req5`

- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/req5:**
A `WCSEO::ReferenceableStitchedMosaic` **shall** conform with Figure 2, 0, and the XML schema being part of this standard.
- Test method:** For each `WCSEO::ReferenceableStitchedMosaic` offered by the server under test, send a *GetCoverage* request to server under test, check the result consists of an XML document of type `WCSEO::ReferenceableStitchedMosaic` as described in the references stated by the requirement. Test passes if all individual tests pass.

Stitched Mosaic: `RectifiedStitchedMosaic`

Test id: `/conf/WCS_profile_earth-observation/1.0/req6`

- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/req6:**
A `WCSEO::RectifiedStitchedMosaic` **shall** conform with Figure 2, 0, and the XML schema being part of this standard.

Test method: For each `WCSEO::RectifiedStitchedMosaic` offered by the server under test, send a *GetCoverage* request to server under test, check the result consists of an XML document of type `WCSEO::RectifiedStitchedMosaic` as described in the references stated by the requirement. Test passes if all individual tests pass.

Domain set: srs of Stitched Mosaic

Test id: /conf/WCS_profile_earth-observation/1.0/req7

Test Purpose: Requirement /req/conf/WCS_profile_earth-observation/1.0/req7:
In a Stitched Mosaic, the `srsName` attribute in the `gml:Envelope` in `gml:boundedBy` **shall** contain the axis labels „Lat” and „Long”, and no other axis labels.

Test method: For all Stitched Mosaics offered by the server under test, send both *DescribeCoverage* and *GetCoverage* request to server under test, and verify that the `srsName` attribute in the `gml:Envelope` in `gml:boundedBy` contain the axis labels only „Lat” and „Long”, and is the same in both responses. Test passes if all individual tests. Test passes if all individual tests pass.

Domain set: supported CRSs

Test id: /conf/WCS_profile_earth-observation/1.0/req8

Test Purpose: Requirement /req/conf/WCS_profile_earth-observation/1.0/req8:
For all Datasets *d* contained in a Stitched Mosaic *s* the following **shall** hold:
The set of supported CRSs of *d* is a subset of the set of supported CRSs of *s*.

Test method: For each Stitched Mosaic:

Send a valid *DescribeCoverage* request to server under test and obtain the contained Datasets in the response. For each obtained Dataset, send a valid *DescribeCoverage* request to server under test.

Check if appropriate results are returned if and only if the requirement is fulfilled.

Test passes if all individual tests pass.

Domain set: axes and uom

Test id: /conf/WCS_profile_earth-observation/1.0/req9

Test Purpose: Requirement /req/conf/WCS_profile_earth-observation/1.0/req9:
For all Datasets *d* contained in a Stitched Mosaic *s* the following **shall** hold:
For all axes, the `uom` attribute of *d* has the same value as the `uom` attribute

of s .

Test method: For each Stitched Mosaic:

Send a valid *DescribeCoverage* request to server under test and obtain the contained Datasets in the response. For each obtained Dataset, send a valid *DescribeCoverage* request to server under test.

Check if appropriate results are returned if and only if the requirement is fulfilled.

Test passes if all individual tests pass.

Domain set: extent

Test id: / conf/WCS_profile_earth-observation/1.0/req10

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/req10:**
For all Datasets d contained in a Stitched Mosaic s the following **shall** hold: in all axes, the domain extent of d is contained in or equal to the domain extent of s in all CRSs supported by s .

Test method: For each Stitched Mosaic:

Send a valid *DescribeCoverage* request to server under test and obtain the contained Datasets in the response. For each obtained Dataset, send a valid *DescribeCoverage* request to server under test.

Check if appropriate results are returned if and only if the requirement is fulfilled.

Test passes if all individual tests pass.

Domain set: pairwise disjoint Datasets in a Stitched Mosaic

Test id: / conf/WCS_profile_earth-observation/1.0/req11

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/req11:**
For all Datasets d_1 and d_2 contained in a Stitched Mosaic s : in all CRSs supported by s , the domain extents of d_1 and d_2 shall be pairwise disjoint.

Test method: For each Stitched Mosaic:

Send a valid *DescribeCoverage* request to server under test and obtain the contained Datasets in the response. For each obtained Dataset, send a valid *DescribeCoverage* request to server under test.

Check if appropriate results are returned if and only if the requirement is fulfilled.

Test passes if all individual tests pass.

Range type

Test id: / conf/WCS_profile_earth-observation/1.0/req12

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/req12:**
For all Datasets *d* contained in a StitchedMosaic *s* the following **shall** hold:
The range type of *d* is identical to the range type of *s* in all components,
except that the nil value set of *d* **shall** be a subset of the nil value set of *s*.

Test method: For each Stitched Mosaic:

Send a valid *DescribeCoverage* request to server under test and obtain the contained Datasets in the response. For each obtained Dataset, send a valid *DescribeCoverage* request to server under test.

Check if appropriate results are returned if and only if the requirement is fulfilled.

Test passes if all individual tests pass.

Range set: nil values

Test id: / conf/WCS_profile_earth-observation/1.0/req13

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/req13:**
The cells of a Stitched Mosaic *s* whose coordinates are located in some embedded Datasets *d* **shall** bear the same cell value as *s* for that given coordinate, all others **shall** bear a nil range value taken from *s*'s nil value set.

Test method: For each Stitched Mosaic:

Send a valid *GetCoverage* request to server under test and obtain the contained cells;

Send a valid *DescribeCoverage* request to server under test and obtain the contained Datasets. For each contained Dataset, send a valid *GetCoverage* request to server under test and obtained the contained cells.

Check if cells of a Stitched Mosaic located in some embedded Datasets bear the same value and cells located in none of these embedded Datasets bear a nil range value taken from Stitched Mosaic's nil value set.

Test passes if all individual tests pass.

Dataset Series: DatasetSeries

Test id: /conf/WCS_profile_earth-observation/1.0/req25

- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/req25:**
A `WCSEO::DatasetSeries` **shall** conform to Figure 2, Table 6, and the XML schema being part of this standard.
- Test method:** For each `WCSEO::DatasetSeries` offered by the server under test, send a *DescribeEOCoverageSet* request to server under test, check the result consists of an XML document of type `WCSEO::EOCoverageSetDescription` as described in the references stated by the requirement. Test passes if all individual tests pass.

Dataset Series: spatial bounding box

- Test id:** /conf/WCS_profile_earth-observation/1.0/req16
- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/req16:**
All EO coverages being referred to by a Dataset Series **shall** lie completely inside the spatial bounding box given in the Dataset Series EO Metadata component.
- Test method:** For each Dataset Series:
- Send a valid *DescribeCoverage* request to server under test and obtain the referred EO coverages in the response. For each obtained EO coverages, send a valid *DescribeCoverage* request to server under test.
- Check if appropriate results are returned if and only if the requirement is fulfilled.
- Test passes if all individual tests pass.

Dataset Series: temporal interval

- Test id:** /conf/WCS_profile_earth-observation/1.0/req17
- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/req17:**
All EO coverages being referred to by a Data set Series therein **shall** have a timestamp falling inside the temporal interval defined in the Dataset Series EO Metadata component.
- Test method:** For each Dataset Series:
- Send a valid *DescribeCoverage* request to server under test and obtain the referred EO coverages in the response. For each obtained EO coverages, send a valid *DescribeCoverage* request to server under test.
- Check if appropriate results are returned if and only if the requirement is fulfilled.
- Test passes if all individual tests pass.

***GetCapabilities* response contents: ServiceIdentification**

Test id: /conf/WCS_profile_earth-observation/1.0/req18

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/req18:**
A WCS service implementing this extension shall include the following URI in the Profile element of the ServiceIdentification in a *GetCapabilities* response:
`http://www.opengis.net/spec/WCS_profile_earth-observation/1.0`

Test method: Determine the list of supported extensions via a valid *GetCapabilities* request; check that the extension required is listed.

***GetCapabilities* response structure**

Test id: /conf/WCS_profile_earth-observation/1.0/req19

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/req19:**
The response to a successful *GetCapabilities* request shall consist of a data structure as defined in Figure 5, Table 7, and the XML Schema being part of this standard.

Dependency: [OGC 09-110r3] Clause 8
(<http://www.opengis.net/doc/IS/WCS/2.0/clause/8>)

Test method: Send a valid *GetCapabilities* request to the server under test, check the result consists of an XML document of type Capabilities and the appropriate components, as defined in the places referenced.

***GetCapabilities* response contents: DatasetSeriesSummary**

Test id: /conf/WCS_profile_earth-observation/1.0/req20

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req20:**
In the response to a successful *GetCapabilities* request containing a WCSEO::DatasetSeriesSummary section, each Dataset Series identifier listed **shall** refer to a Dataset Series offered by the server

Test method: Send a *GetCapabilities* request to the service under test. If a WCSEO::DatasetSeriesSummary section is contained in the response then send, for each *DatasetSeriesId*, a valid *DescribeCoverage* request. Check that none of these requests results in an exception. Test passes if all checks are successful.

***DescribeCoverage* response contents: EOMetadata**

Test id: /conf/WCS_profile_earth-observation/1.0/req21

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req21:**
In the response to a successful *DescribeCoverage* request, one `GMLEO::EOMetadata` element **shall** be present containing the EO Metadata component of the coverage addressed

Test method: For each Dataset or Stitched Mosaic offered by the server on hand, send a valid *DescribeCoverage* request to server under test. Check that the result contains an `EOMetadata` element. Test passes if all individual tests pass.

GetCoverage response contents: Stitched Mosaics

Test id: `/conf/WCS_profile_earth-observation/1.0/req22`

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req22:**
For EO coverages, Stitched Mosaics are interpreted as single 2-D coverages with their EO Metadata record (plus any eventual other, non-EO metadata). The response to a successful *GetCoverage* request on a Stitched Mosaic **shall** be a Dataset substructuring into Datasets is not visible, the coverage appears “flattened”.

Test method: For each Stitched Mosaic offered by the server on hand, send a valid *GetCoverage* request to server under test. Check that the result contains a valid Stitched Mosaic. Test passes if all individual tests pass.

GetCoverage response contents: EOMetadata

Test id: `/conf/WCS_profile_earth-observation/1.0/req23`

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req23:**
In the response to a successful *GetCoverage* request, the `EOMetadata` component **shall** consist of the EO Metadata component of the coverage addressed.

Test method: For all Dataset or Stitched Mosaic offered by the server under test, retrieve coverage information via both *DescribeCoverage* and *GetCoverage* operations. Verify that both responses contain an EO Metadata component, and that both responses contain the same information. Test passes if all individual tests pass.

GetCoverage response contents: Lineage

Test id: `/conf/WCS_profile_earth-observation/1.0/req24`

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req24:**
In the response to a successful *GetCoverage* request, the Lineage compo-

ment **shall** consist of the Lineage component of the coverage with one record appended which **describes** the *GetCoverage* operation applied.

Test method: TBD

DescribeEOCoverageSet request

Test id: /conf/WCS_profile_earth-observation/1.0/req25

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req25:**
A *DescribeEOCoverageSet* request **shall** consist of a structure as defined in Figure 6 and 0.

Test method: Send *DescribeEOCoverageSet* requests with valid and invalid request structure. Pass test if appropriate valid results or exceptions, resp., are delivered.

DescribeEOCoverageSet request: identifier

Test id: /conf/WCS_profile_earth-observation/1.0/req26

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req26:**
The `eoId` parameter value in a *DescribeEOCoverageSet* request **shall** be equal to the identifier of a Dataset, a Stitched Mosaic, or a Dataset Series offered by the server addressed.

Test method: Send valid *DescribeEOCoverageSet* requests to server under test addressing existing and non-existing identifier of a Dataset, a Stitched Mosaic, or a Dataset Series, resp. Check if appropriate results or exceptions, resp., are delivered.

DescribeEOCoverageSet request: DimensionTrim

Test id: /conf/WCS_profile_earth-observation/1.0/req27

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req27:**
A *DescribeEOCoverageSet* request **shall** contain one or none dimension component for coverage axes „Lat”, „Long”, and „phenomenonTime”.

Test method: TBD

DescribeEOCoverageSet response: structure

Test id: /conf/WCS_profile_earth-observation/1.0/req28

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req28:**
The response to a successful *DescribeEOCoverageSet* request **shall** consist of a `WCS::CoverageDescriptions` structure as described in WCS Core [OGC 09-110r3] Table 11 Figure 7.

Dependency: WCS Core [OGC 09-110r3] Subclause 8.3.2 (TBD)

(`wcs::CoverageDescriptions`, but with metadata specialized to contain EO metadata records) TBD

Test method: TBD

DescribeEOCoverageSet response: CoverageDescriptions

Test id: /conf/WCS_profile_earth-observation/1.0/req29

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req29:**
The response to a successful *DescribeEOCoverageSet* request **shall** contain, in its `WCS::CoverageDescriptions` structure, at most one `EOGML::EOMetadata` record for each Dataset

- whose coverage id equals `eoId`, or
- which is referenced by a Stitched Mosaic whose coverage id equals `eoId`, or
- which is referenced by some Stitched Mosaic which is referenced by a Dataset Series whose id equals `eoId`.

Test method: Send a valid *DescribeEOCoverageSet* request to server under test. Check that the response contains at most one `EOMetadata` in its `WCS::CoverageDescriptions`. For each coverage id offered by the server on hand, send a valid *DescribeCoverage* request to server under test and verify that the response is not an exception. Test passes if all individual tests pass.

DescribeEOCoverageSet response: CoverageDescription

Test id: /conf/WCS_profile_earth-observation/1.0/req30

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req30:**
Each `WCS::CoverageDescription` listed in the response to a successful *DescribeEOCoverageSet* request **shall** contain one `wcs:metadata` element whose contents is identical to the `GMLEO::EOMetadata` component of the EO coverage to be described.

Test method: Send a valid *DescribeEOCoverageSet* request to server under test. Check that each *CoverageDescription* contains one `EOMetadata`. For the coverage id offered in the *CoverageDescription* on hand, send a valid *DescribeCoverage* request to server under test and verify that both `EOMetadata` contain the same information. Test passes if all individual tests pass.

DescribeEOCoverageSet response: *latitude/longitude* bounding

Test id: /conf/WCS_profile_earth-observation/1.0/req31

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req31:**
The response to a successful *DescribeCoverageSet* request **shall** contain only descriptions of those EO Coverages whose `gml:Envelope`
- overlaps with the request *latitude/longitude* bounding box, in case the request parameter `mode` is of value `OVERLAPS`,
- is completely contained within the request *latitude/longitude* bounding box, in case the request parameter `mode` is of value `CONTAINS`.

Test method: Send a valid *DescribeEOCoverageSet* request with request parameter `mode` is of value `OVERLAPS` to server under test. In the response, check that there is no EO Coverage whose `gml:Envelope` is outside the request *latitude/longitude* bounding;

Send a valid *DescribeEOCoverageSet* request with request parameter `mode` is of value `CONTAINS` to server under test. In the response, check that all `gml:Envelopes` of the return EO Coverages are inside the request *latitude/longitude* bounding;

Test passes if both tests pass.

DescribeEOCoverageSet response: time interval

Test id: /conf/WCS_profile_earth-observation/1.0/req32

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req32:**
The response to a successful *DescribeCoverageSet* request **shall** contain only descriptions of those EO Coverages whose `gml:Envelope`
- overlaps with the request time interval, in case the request parameter `mode` is of value `OVERLAPS`,
- is completely contained within the request time interval, in case the request parameter `mode` is of value `CONTAINS`

Test method: Send a valid *DescribeEOCoverageSet* request with request parameter `mode` is of value `OVERLAPS` to server under test. In the response, check that there is no EO Coverage whose `gml:Envelope` is outside the request time interval;

Send a valid *DescribeEOCoverageSet* request with request parameter `mode` is of value `CONTAINS` to server under test. In the response, check that all `gml:Envelopes` of the return EO Coverages are inside the request time interval;

Test passes if both tests pass.

Band Subsetting Extension

- Test id:** /conf/WCS_profile_earth-observation/1.0/req33
- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req33:** Implementations of this Earth Observation Application Profile **shall** support the WCS 2.0 Band Subsetting Extension.
Dependency: http://www.opengis.net/spec/WCS_service-model_band-subsetting/1.0/conf/bad-subsetting
- Test method:** Determine the list of supported extensions via a valid *GetCapabilities* request; check that the extension required is listed.

Scaling & Interpolation Extension

- Test id:** /conf/WCS_profile_earth-observation/1.0/req34
- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req34:** Implementations of this Earth Observation Application Profile **shall** support the WCS 2.0 Scaling & Interpolation Extension.
Dependency: http://www.opengis.net/spec/WCS_service-model_scaling+interpolation/1.0/conf/scaling+interpolation
- Test method:** Determine the list of supported extensions via a valid *GetCapabilities* request; check that the extension required is listed.

WCS 2.0 EPSG CRS Extension

- Test id:** /conf/WCS_profile_earth-observation/1.0/req35
- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req35:** Implementations of this Earth Observation Application Profile **shall** support the WCS 2.0 EPSG CRS Extension.
Dependency: http://www.opengis.net/spec/WCS_service-model_crs-epsg/1.0/conf/crs-epsg
- Test method:** Determine the list of supported extensions via a valid *GetCapabilities* request; check that the extension required is listed.

Encoding extensions

- Test id:** /conf/WCS_profile_earth-observation/1.0/req36
- Test Purpose:** **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req36:** Implementations of the Earth Observation Application Profile **shall** support at least one of the WCS 2.0 coverage format encodings GeoTIFF, NetCDF, and JPEG2000.
Dependency: conformance classes

TBD: adjust to “GML” extension mechanics

Test method: Determine the list of supported extensions via a valid *GetCapabilities* request; check that the extension required is listed.

Protocol-binding extensions

Test id: /conf/WCS_profile_earth-observation/1.0/req37

Test Purpose: **Requirement /req/conf/WCS_profile_earth-observation/1.0/ req37:** Implementations of this Earth Observation Application Profile **shall** support at least one of the WCS 2.0 protocol extensions GET/KVP and SOAP.

Dependency:

http://www.opengis.net/spec/WCS_protocol-binding_get-kvp/1.0/conf/get-kvp

http://www.opengis.net/spec/WCS_protocol-binding_soap/1.0/conf/soap

Test method: Determine the list of supported extensions via a valid *GetCapabilities* request; check that the extension required is listed.

A.2 Conformance Test Class: ap-eo_get-kvp

A.3 Conformance Test Class: ap-eo_soap

-- end of ATS --