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OGC Web Coverage Service (WCS) 2.1 Interface Standard - Core

Copyright notice

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i. Abstract

The OGC Web Coverage Service (WCS) supports electronic retrieval of geospatial data as "coverages." Coverages are digital geospatial information representing space/time-varying phenomena, specifically spatio-temporal regular and irregular grids, point clouds, and general meshes.

This document specifies the WCS core. Every implementation of a WCS shall adhere to this standard. This standard defines core requirements. Extensions to the core define extensions to meet additional requirements, such as the response encoding. Additional extensions are required in order to completely specify a WCS for implementation.

This WCS 2.1 standard extends WCS 2.0 in a backwards compatible manner by accommodating coverages as per the OGC Coverage Implementation Schema (CIS) 1.1 in addition to CIS 1.0 coverages as addressed by WCS 2.0.

ii.   Keywords

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

ogcdoc, OGC document, coverage, Web Coverage Service, grid, mesh

iii.   Preface

This document specifies the OGC Web Coverage Service (WCS) core requirements, which are mandatory for any implementation claiming to be conformant with WCS. The WCS standard is based on the Coverage Implementation Schema (CIS), OWS Common, and OGC Abstract Topic 6. WCS 2.1 extends WCS 2.0 (which establishes how to offer coverages as per CIS 1.0) so that 2.1 servers may additionally offer coverages as per CIS 1.1. Therefore, WCS 2.1 is backwards compatible with WCS 2.0. Any service passing the WCS 2.1 conformance tests will also pass the WCS 2.0 tests. Further, all WCS 2.x extensions remain applicable in the context of WCS 2.1.

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

iv.   Security Considerations

No security considerations have been made for this standard

v.   Submitting organizations

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

- Jacobs University Bremen
- rasdaman GmbH
- Envitia Ltd
- European Union Satellite Center

vi.   Submitters

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

Name	Affiliation
Peter Baumann	Jacobs University Bremen, rasdaman GmbH

1.   Scope

This document specifies how a Web Coverage Service (WCS) offers multi-dimensional (usually spatio-temporal) coverage data for access over the Internet. This document relies on and extends WCS 2.0, which operates on coverages as per the OGC Coverage Implementation Schema (CIS) 1.0, with support for coverages as per CIS 1.1.

All WCS 2.0 service extension standards remain applicable under WCS 2.1. However, in order to accommodate CIS 1.1 some extensions may need to be enhanced, leading to a minor version updates.

2.   Conformance

Standardization target are WCS 2.1 implementations (currently: servers).

This document establishes a single requirements class, *core*, http://www.opengis.net/spec/WCS /2.1/req/core with a single pertaining conformance class, *core*, with URI http://www.opengis.net /spec/WCS/2.1/conf /core. Requirements and conformance test URIs defined in this document are relative paths to be appended to http://www.opengis.net/spec/WCS/2.1/.

Conformance with this standard shall be checked using all the relevant tests specified in Annex A (normative) of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the OGC Compliance Testing Policies and Procedures and the OGC Compliance Testing web site[1].

In order to conform to this OGC®interface standard, a software implementation shall choose to

implement:

a)   Any one of the conformance levels specified in Annex A (normative).

All requirements-classes and conformance-classes described in this document are owned by the standard(s) identified.

3.   References

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

- OGC: OGC 07-011, Abstract Specification Topic 6: The Coverage Type and its Subtypes, version 7 (identical to ISO 19123:2005), 2007

- OGC: OGC 06-121r9, OGC Web Service Common Specification, version 2.0, 2010

    ·   Conformance classes used: *GetCapabilitiesoperation* (Clause 7)

- OGC: OGC 09-146r2, OGC® Coverage Implementation Schema, version 1.0, 2012

    ·   Conformance classes used: *coverage*

- OGC: OGC 09-146r6, OGC® Coverage Implementation Schema, version 1.1, 2017

    ·   Conformance classes used: *coverage*

- OGC: OGC 09-110r4, OGC® Web Coverage Service – Core, version 2.0, 2012

    ·   Conformance classes used: *core*

- OGC: OGC 16-083r2, Coverage Implementation Schema – ReferenceableGridCoverage Extension, version 1.0, 2017

    ·   Conformance classes used: *gmlcovrgrid*

4.   Terms and Definitions

This document uses the terms defined in Sub-clause 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.

For the purposes of this document, all terms and definitions in OGC Abstract Specification Topic 6 apply.

5.   Conventions

5.1   UML notation

Unified Modeling Language (UML) static structure diagrams appearing in this standard are used as described in Sub-clause 5.2 of OGC Web Service Common [OGC 06-121r9]. Further, the following conventions hold.

- UML elements having a package name of "OWS Common" are those defined in the UML model of OWS Common [OGC 06-121r9].
- UML elements having a package name of GML are those defined in the UML model of GML [OGC 07-036].
- UML elements having a package name of "SWE Common" are those defined in the UML model of SWE Common [OGC 08-094].
- UML elements having a package name of CIS are those defined in the UML model of CIS 1.0 [OGC 09-146r2].
- UML elements not qualified with a package name are those defined in this Standard.
- UML data type Any is used here as an equivalent to XML's xsd:any.

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 Sub-clause 5.5 of [OGC 06-121r9]. The contents of these data dictionary tables are normative, including any table footnotes.

For the reader's convenience, table rows describing inherited components are shaded.

5.3   Namespace prefix conventions

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

Prefix	Namespace URI	Description
xsd	http://www.w3.org/2001/XMLSchema	XML Schema
gml32	http://www.opengis.net/gml/3.2	GML 3.2.1
gml33	http://www.opengis.net/gml/3.3	GML 3.3
swecommon20	http://www.opengeospatial.org/standards/swecommon	SWE Common 2.0
cis10	http://www.opengis.net/cis/1.0	CIS 1.0 (aka GMLCOV 1.0)
cis11	http://www.opengis.net/cis/1.1	CIS 1.1

Table 1: Namespace mappings

wcs20	http://www.opengis.net/wcs/2.0	WCS 2.0
gmlcovrgrid10	http://www.opengis.net/gmlcov/gmlcovrgrid/1.0	GMLCOV/CIS 1.0 Referenceable Grid Extension
wcs21	http://www.opengis.net/wcs/2.1	WCS 2.1

6. WCS Data Model

A WCS server offers a – possibly empty – set of coverage objects, each of which can be either a CIS 1.0 coverage or a CIS 1.1 coverage.

7. WCS Service Model

The WCS Core service model is identical to WCS 2.0, but extended with CIS 1.1 coverages in its offering (Figure 1). In particular, the requests syntax and semantics remain unchanged so that a WCS 2.1 server offers the services established in WCS Core 2.0 [OGC 09-110r4] on both CIS 1.0 [OGC 09-146r2] and CIS 1.1 [OGC 09-146r6] coverages. Syntax is added which allows differentiating between CIS 1.0 and CIS 1.1 structures as results.

Figure 1: WCS CoverageOfferings UML class diagram
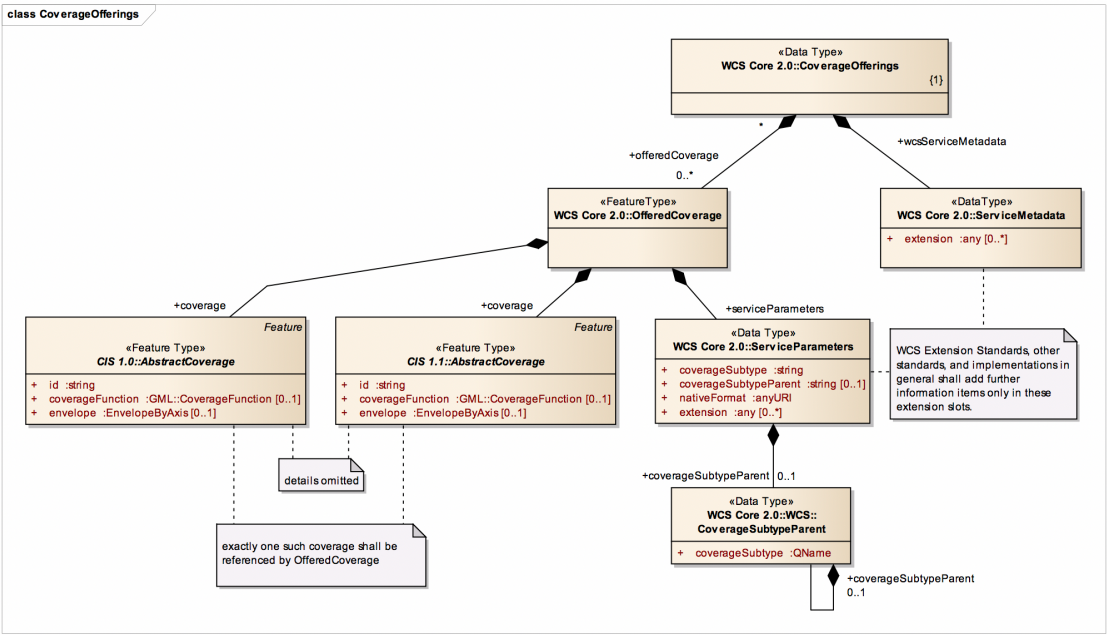
NOTE 1   As per OGC Web Services, the functionality of extensions listed in the Capabilities is available on all coverages offered, both CIS 1.0 and 1.1.

NOTE 2   There is no formal requirement on the contents of this diagram because it will be a segue of the requirements on requests.

Extended behavior of WCS 2.1 over WCS 2.0 is described in the following clauses.

8.   WCS Core Operations

8.1   GetCapabilities operation

The WCS2.1 *GetCapabilities* request is identical to the definition provided in WCS 2.0.

The WCS 2.1 *GetCapabilities* response additionally reports CIS 1.1 coverages.

Requirement 1   /req/core/getCapabilities-cis11:
The *GetCapabilities* request of a WCS 2.1 server **shall** handle CIS 1.0 [OGC 09-146r2] and CIS 1.1 [OGC 09-146r6] coverages identically.
Dependency:http://www.opengis.net/spec/WCS/2.0/conf/core,
http://www.opengis.net/spec/CIS/1.0/conf/coverage, http://www.opengis.net/spec/CIS/1.1/conf/coverage

NOTE   Often a single implementation will support both WCS 2.0 and 2.1 requests. However, both will not necessarily return the same list of coverages offered: a *GetCapabilities* request against a WCS 2.0 server will **only** list CIS 1.0 coverages, but **not** list any CIS 1.1 coverages as these are unknown per definition of WCS 2.0 and cannot be retrieved through a WCS 2.0 *DescribeCoverage* or *GetCoverage* request – whereas under a WCS 2.1 regime, both CIS 1.0 and CIS 1.1 coverages will be listed, if any.

8.2   DescribeCoverage operation

The WCS 2.1 *DescribeCapabilities* request is identical to its definition in WCS 2.0.

The WCS 2.1 *DescribeCoverage* response is identical to WCS 2.0 for CIS 1.0 coverages; for CIS 1.1 coverages, the response structure is adjusted accordingly.

Requirement 2   /req/core/describeCoverage-cis11:
The response to a successful *DescribeCoverage*request on a CIS 1.1 coverage [OGC 09-146r6] **shall**consist of a CoverageDescriptions element as described in Figure 2 and Table 2.

Table 2 lists the structure of the CIS 1.1 enhanced subtype WCS 2.1::CoverageDescription. Depending on the coverage type requested the result will be a WCS 2.0 coverage description (for CIS 1.0 coverages) or a WCS 2.10 description (for CIS 1.1 coverages).

Name	Definition	Data type	Multiplicity
coverage-Function	GML 3.2.1 coverage function to describe how range values at coverage locations can be obtained	GML 32:: CoverageFunction	zero or one (optional)
envelope	Coverage bounding box	CIS 1.0::Envelope	zero or one (optional)
domainSet	Domain extent description of this coverage	CIS 1.0::DomainSet or	zero or one (optional)

Table 2: WCS CoverageDescription components
(extended component white, all components inherited without modifications grey)

		CIS 1.1::DomainSet	
rangeType	Range structure description of this coverage	SWE Common 2.0:: DataRecord	one (mandatory)
metadata	Application-specific metadata	CIS 1.0::Metadata	zero or more (optional)
service-Parameters	Service-specific parameters of this coverage	WCS 2.0:: Service-Parameters	one (mandatory)

To keep response size moderate, a coverage description does not include any recursively nested coverages, nor position/value pairs. To still provide information about the domain extent, the coverage envelope is mandatory in this case.

Requirement 3   /req/core/no-description-nesting:
The response to a successful *DescribeCoverage*request on a CIS 1.1 coverage [OGC 09-146r6] which contains a CIS 1.1::PartitionSet**shall**not contain a CIS 1.1:: PartitionSet and **shall**contain an envelope.

NOTE   The domain set description variants added in CIS 1.1 [OGC 09-146r6] allow for recursive coverage nestings through the PartitionSet component, which obviously should be copied into a coverage description (which intuitively is expected to be comparatively small in size). However, beware that the domain extent description still can be large – the domain set of a CIS 1.0::ReferenceableGridCoverage and a CIS 1.1::DisplacementAxisNest ("warped") coverage (CIS 1.1 conformance class grid-irregular) may grow as big as the range set, and actually can exceed its size, in certain situations.
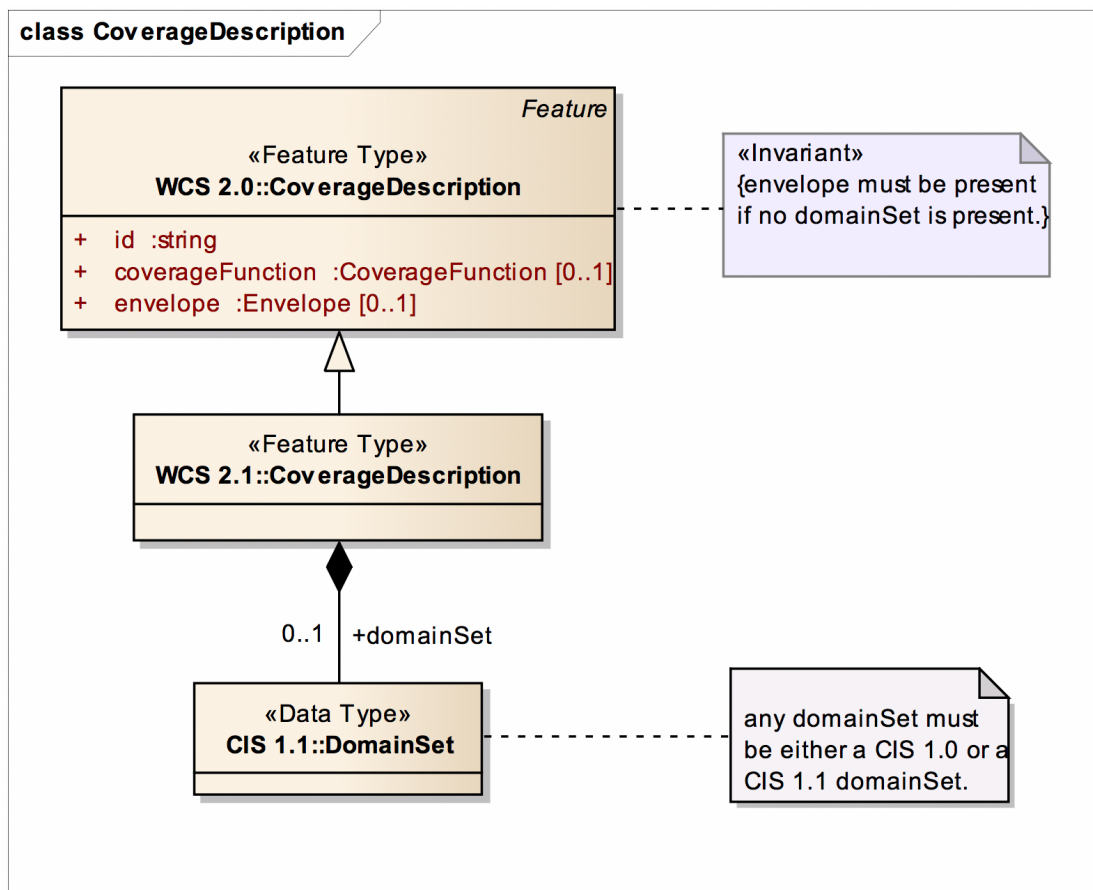
Figure 2: WCS CoverageDescription UML class diagram

Example: The response to a valid *DescribeCoverage* request for CIS 1.1 GeneralGridCoverage with id *C0001* might be:

```
< CoverageDescriptions
    xmlns='http://www.opengis.net/wcs/2.1/gml'
    xmlns:cis11='http://www.opengis.net/cis/1.1/gml'
    xmlns:gml='http://www.opengis.net/gml/3.2'
    xmlns:swe='http://www.opengis.net/swe/2.0'
    xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance'
    xsi:schemaLocation=
                       'http://www.opengis.net/swe/2.0
http://schemas.opengis.net/sweCommon/2.0/swe.xsd
                        http://www.opengis.net/wcs/2.1/gml
http://schemas.opengis.net/wcs/2.1/gml/wcsAll.xsd'>
    <CoverageDescription gml:id="C0001">
        <cis11:envelope srsName=http://www.opengis.net/def/crs
/EPSG/0/4326
            axisLabels="Lat Long" srsDimension="2">
            <cis11:axisExtent axisLabel="Lat"  uomLabel="deg"
lowerBound="1" upperBound="5"/>
            <cis11:axisExtent axisLabel="Long" uomLabel="deg"
lowerBound="1" upperBound="3"/>
        </cis11:envelope>
        <cis11:domainSet>
            <cis11:generalGrid srsName=http://www.opengis.net
```

```
/def/crs/EPSG/0/4326
                    axisLabels="Lat Long">
                    <cis11:regularAxis axisLabel="Lat"
 uomLabel="deg" lowerBound="1" upperBound="5"
                        resolution="1"/>
                    <cis11:regularAxis axisLabel="Long"
 uomLabel="deg" lowerBound="1" upperBound="3"
                        resolution="1"/>
                    <cis11:gridLimits
 srsName="http://www.opengis.net/def/crs/OGC/0/Index2D"
 axisLabels="i j">
                        <cis11:indexAxis axisLabel="i"
 lowerBound="0" upperBound="2"/>
                        <cis11:indexAxis axisLabel="j"
 lowerBound="0" upperBound="2"/>
                    </cis11:gridLimits>
                </cis11:generalGrid>
            </cis11:domainSet>
            <cis11:rangeType>
                <swe:DataRecord>
                    <swe:field name="singleBand">
                        <swe:Quantity
 definition="http://www.opengis.net/def/property/OGC/0/Radiance">
                            <swe:description>Panchromatic
 Channel</swe:description>
                            <swe:uom code="W/cm2"/>
                        </swe:Quantity>
                    </swe:field>
                </swe:DataRecord>
            </cis11:rangeType>
            <ServiceParameters>
                <CoverageSubtype>GridCoverage</CoverageSubtype>
                <nativeFormat>image/tiff</nativeFormat>
            </ServiceParameters>
        </CoverageDescription>
 </CoverageDescriptions>
```

8.3   GetCoverage operation

The *GetCoverage* request is identical to its definition in WCS 2.0: coverages offered can be retrieved. However, more coverage types than in WCS 2.0 can be queried in WCS 2.1, as is detailed in the extended response definition below.

The WCS 2.1 *GetCoverage* response is extended over WCS 2.0 (supporting CIS 1.0 only) to allow CIS 1.1, the Referenceable Grid Coverage extension, and GML 3.3.

Requirement 4   **/req/core/getCoverage-cis11:**
The contents of the response to a successful WCS 2.1 *GetCoverage* request **shall** be a concrete

subtype of either CIS 1.0::AbstractCoverage or CIS 1.1::AbstractCoverage or GMLCOVRGRID 1.0:: ReferenceableGridCoverage or a GML 3.3 coverage type.
Dependency:http://www.opengis.net/spec/WCS/2.0/conf/core, http://www.opengis.net/spec/CIS/1.0/conf/coverage, http://www.opengis.net/spec/CIS/1.1/conf /coverage

NOTE   Currently, no translation between coverage types is defined so implementations should not be expected to perform any (although the specification does not exclude it); however, such functionality may be defined in future, e.g., through a bespoke WCS Extension.

8.4   Exceptions

Exceptions are the same as in WCS 2.0.

Annex A: Conformance Class Abstract Test Suites (Normative)

A.1   Conformance Test Class: core

The OGC URI identifier of this conformance class is: http://www.opengis.net/spec/WCS/2.1/conf/core.

Tests identifiers below are relative to http://www.opengis.net/spec/WCS/2.1/.

A.1.1   *GetCapabilities*lists CIS 1.1 coverages

Test id:	**/conf/core/getCapabilities-cis11**
Test Purpose:	**Requirement /req/core/getCapabilities-cis11:** The *GetCapabilities* request of a WCS 2.1 server **shall** handle CIS 1.0 [OGC 09-146r2] and CIS 1.1 [OGC 09-146r6] coverages identically. **Dependency:** http://www.opengis.net/spec/WCS/2.0/conf/core, http://www.opengis.net/spec/CIS/1.0/conf/coverage, http://www.opengis.net/spec/CIS /1.1/conf/coverage
Test method:	Provide at least one CIS 1.1 coverage on server under test. Send a *GetCapabilities* request to this server, check that the result lists all CIS 1.1 coverages inserted.

A.1.2 *DescribeCoverage* response structure for CIS 1.1 coverages

Test id:	**/conf/core/describeCoverage-cis11**

Test Purpose:	**Requirement /req/core/describeCoverage-cis11:** The response to a successful *DescribeCoverage* request on a CIS 1.1 coverage [OGC 09-146r6] **shall** consist of a CoverageDescriptions element as described in Figure 2 and Table 2.

Test method:	Provide at least one CIS 1.1 coverage on the server under test. Send a *DescribeCoverage* request on these coverages to server under test, check the result consists of a structure as described in the requirement. Test passes if all individual tests pass.

A.1.3 *DescribeCoverage* response without CIS 1.1 partitionSet

Test id:	**/conf/core/describeCoverage-cis11-no-nesting**

Test Purpose:	**Requirement /req/core/no-description-nesting:** The response to a successful *DescribeCoverage* request on a CIS 1.1 coverage [OGC 09-146r6] which contains a CIS 1.1::PartitionSet **shall** not contain a CIS 1.1::PartitionSet and **shall** contain an envelope.

Test method:	Provide at least one CIS 1.1 coverage on the server under test which contains a partitionSet. Send a *DescribeCoverage* request on these coverages to server under test. Check that the results fulfil the requirement. Test passes if all individual tests pass.

A.1.4 *GetCoverage* response structure for CIS 1.1 coverages

Test id:	**/conf/core/getCoverage-cis11**

Test Purpose:	**Requirement /req/core/getCoverage-cis11:** The contents of the response to a successful WCS 2.1 *GetCoverage* request **shall** be a concrete subtype of either CIS10::AbstractCoverage or CIS11::AbstractCoverage. **Dependency:** http://www.opengis.net/spec/WCS/2.0/conf/core, http://www.opengis.net/spec/CIS/1.0/conf/coverage, http://www.opengis.net/spec/CIS/1.1/conf/coverage

| **Test method:** | Provide at least one CIS 1.1 coverage on the server under test. Send a *GetCoverage* request on these coverages to server under test, executing all WCS Core functionalities: complete download, trimming, slicing, format encoding. Check that the results of these operations are correct as per their specification in WCS 2.0. Test passes if all individual tests pass. |

– end of ATS –

Annex B: Revision history

Date	Release	Author	Paragraph modified	Description
2016-02-14	2.1.0	Peter Baumann	all	created
2017-11-25	2.1.0	Peter Baumann	several	Implemented change requests from voting

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[1] www.opengeospatial.org/cite