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OGC® Web Coverage Service Interface Standard - Interpolation Extension

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i. Preface

OGC® Web Coverage Service Interface Standard - Interpolation Extension (this document) specifies parameters to the OGC Web Coverage Service (WCS) *GetCoverage* request which give control over interpolation of a coverage during its server-side processing.

Suggested additions, changes, and comments on this draft document are welcome and encouraged. Such suggestions may be submitted through the OGC Change Request process.

ii. Terms and definitions

This document uses the standard terms defined in Subclause 5.3 of the OGC Web Services Common standard [2] 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.:

- Constructor University
- Fuzhou University
- NRCan

iv. Document Contributor Contact Points

Name	Organization
Peter Baumann	Constructor University
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v. Changes to the OGC Abstract Specification

The OGC Abstract Specification does not require any changes to accommodate the technical contents of this document.

vi. Future Work

Among the topics for future development are the following items:

- None foreseen currently.

Foreword

The WCS Interpolation extension is dependent on requirements specified in the WCS Core Standard [OGC 17-089r1] and the Coverage Implementation Schema (CIS) Standard 1.0 [OGC 09-146r8] onwards.

This document includes one normative Annex.

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.

Introduction

The OGC *Web Coverage Service (WCS) –Interpolation Extension* defines an extension to the WCS Core [OGC 17-089r1] to control interpolation during processing of a *GetCoverage* request. This affects all operations that require interpolation, such as subsetting, scaling and Coordinate Reference System (CRS) transformation.

Note As such, this Interpolation Extension has impact on the operational behaviour described in other WCS extensions, such as subsetting.

The set of interpolation types supported is usually a property of a coverage. In reality, interpolation can be even more localized and constitute a property of particular coverage axes and on particular bands. For example, a coverage may undergo linear interpolation along lat/long axes and nearest neighbour interpolation along the time axis.

However, fine-grained modelling interpolation would impose a severe load on WCS implementations and backend services. Server implementation is significantly complicated by a dynamic per-axis choice of interpolation methods applied. Reporting interpolation capabilities with individual coverages would lead to more metadata, and would substantially complicate client-side handling of this information.

Therefore, a mixed approach is adopted in this WCS Interpolation Extension. In the core conformance class, one interpolation method can be selected by the client which subsequently gets applied along all coverage axes simultaneously. In an optional conformance class, *interpolation-per-axis*, the implementation can override by axis the different interpolation method to be applied.

Interpolation methods available are reported by the service in its *GetCapabilities* response. A normative enumeration of specific interpolation techniques is provided in OGC Abstract Topic 6.1 (which is identical to ISO 19123-1) [1]; The OGC Naming Authority (OGC-NA) may normatively establish URLs for these interpolation methods.

An implementation of the WCS Interpolation Extension does not automatically mean that interpolation parameters provided with a request have an effect. Only for operations involving interpolation – such as subsetting, scaling or reprojection – will such parameters affect the result.

OGC® Web Coverage Service Interface Standard - Interpolation Extension

1 Scope

This OGC WCS Interpolation Extension (*Interpolation Extension*) defines how a client can control interpolation(s) performed by a server during *GetCoverage* interpolation, should an interpolation be specified as part of the request evaluation.

2 Conformance

This document establishes the following requirements and conformance classes:

- *interpolation*: https://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/req/interpolation. The corresponding conformance class is *interpolation*: https://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/conf/interpolation.

  This is the mandatory core conformance class of this extension.

- *interpolation-per-axis*: https://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/req/interpolation-per-axis. The corresponding conformance class is *interpolation-per-axis*: https://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/conf/interpolation-per-axis.

The standardisation target of all requirements and conformance classes defined in this Standard are WCS implementations (currently: servers).

Requirements URIs defined in this document are relative to https://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/req, conformance test URIs defined in this document are relative to https://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/conf.

Annex A defines the Conformance Test Suite lists the conformance tests which SHALL be exercised on any software artefact claiming to implement WCS.

3 Normative references

This *OGC WCS Interpolation Extension* Standard consists of this document and an XML Schema. The complete Standard is identified by OGC URI https://www.opengis.net/spec/WCS_service-extension_interpolation/1.1. This document is identified by OGC URI https://www.opengis.net/doc/IS/WCS_service-extension_interpolation/1.1.

The complete Standard is available for download from https://www.opengeospatial.org/standards/wcs. Additionally, the XML Schema is posted online at https://schemas.opengis.net/wcs/interpolation/1.1 in 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 normative documents listed in Table 1 contain provisions that, through reference in this text, constitute provisions of this Standard. 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.

Table 1 — Conformance class dependencies

Interpolation conformance class	Dependency document	Dependency conformance class
Interpolation	OGC 09-110, *OGC® Web Coverage Service 2.0 Interface Standard - Core*, version 2.0	*Core*
interpolation-per-axis	This Standard	*Interpolation*

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. An arrow "→" indicates that the following term is defined in this Clause.

4.1 Interpolation (of a coverage)

Estimation of a – non-existing – new range value of a coverage for a location in the coverage which is situated between positions containing range values

5 Conventions

5.1 UML notation

Unified Modelling 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 as 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 Standard. The prefix abbreviations used constitute conventions used here, but are **not** normative. The namespaces to which the prefixes refer are normative.

Table 2 — Namespace mappings

Prefix	Namespace URI	Description
xsd	https://www.w3.org/2001/XMLSchema	XML Schema namespace
gml	https://www.opengis.net/gml/3.2	GML 3.2.1
cis	https://www.opengis.net/cis/1.1	Coverage Implementation Schema 1.1
wcs	https://www.opengis.net/wcs/2.0	WCS 2.0 Core
int	https://www.opengis.net/wcs/interpolation/1.1	WCS Interpolation Extension

5.4 Multiple representations

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

6 *Interpolation* requirements class

6.1 Overview

This Clause 6 establishes the Interpolation Extension core conformance class, *interpolation*. Clients and servers supporting this requirements class allow choosing an interpolation method to be applied whenever interpolation takes place during *GetCoverage* request evaluation. The interpolation method chosen is applied simultaneously along all axes.

6.2 Modifications to *GetCapabilities*

A server announces support of the *interpolation* conformance class to a client by adding the URL identifying this extension to the list of supported extensions delivered in the Capabilities document.

Requirement 1 interpolation/interpolation-identifier:
A WCS service implementing conformance class *interpolation* of the Interpolation Extension **SHALL** include the following URI in the `Profile` element of the `ServiceIdentification` in a *GetCapabilities* response:
`http://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/conf/interpolation`

Requirement 2 interpolation/capabilities:
The response to a successful *GetCapabilities* request **SHALL** adhere to Figure 1, Table 2, and the XML schema defined for this Interpolation Extension.

Figure 1 presents the UML diagram of the extended Capabilities document. Table 2 details the components added.

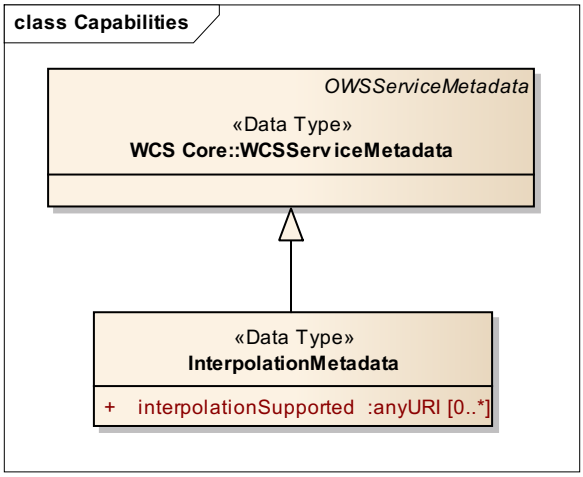

Figure 1 — `Capabilities` UML diagram with `InterpolationMetadata` component

Table 3 — Components of `Int::InterpolationMetadata` structure

Name	Definition	Data type	Multiplicity
`interpolation-Supported`	Identifier(s) of interpolation method(s) supported by the server	List of `anyURI`	zero or more (optional)

Requirement 3 interpolation/wcsServiceMetadata:
The response to a successful *GetCapabilities* request **SHALL** contain an `Interpolation-Metadata` element.

Example The following list is returned in the Capabilities document of a server supporting nearest-neighbor, linear, and quadratic interpolation (the URLs in the following example are fictitious; see OGC-NA for actually standardized interpolation URIs):

```
<int:InterpolationMetadata>
    <int:InterpolationSupported>
        http://www.opengis.net/def/interpolation/OGC/1/nearest-neighbor
    </int:InterpolationSupported>
    <int:InterpolationSupported>
        https://www.opengis.net/def/interpolation/OGC/1/linear
    </int:InterpolationSupported>
    <int:InterpolationSupported>
        http://www.opengis.net/def/interpolation/OGC/1/quadratic
    </int:InterpolationSupported>
</int:InterpolationMetadata>
```

Requirement 4 interpolation/wcsServiceMetadata-interpolationMethods:
The `interpolationSupported` item(s) delivered in the `ServiceMetadata` element of the response to a successful *GetCapabilities* request **SHALL** consist of a pairwise distinct list of URLs.

Note The above requirement tentatively does not constrain the admitted URLs to those defined in the *-interpolation requirements classes of this Standard. This allows vendors to support further types of interpolation. However, implementations should use the interpolation URLs for those interpolation types this standard provides definitions for.

6.3 Modifications to *DescribeCoverage*

None.

6.4 Modifications to *GetCoverage*

6.4.1 Modifications to the *GetCoverage* request

The *GetCoverage* request is extended with a parameter, `globalInterpolation` that specifies what interpolation technique is to be applied by the server when preparing the *GetCoverage* response. This interpolation is applied uniformly on all axes of the resulting coverage.

Note In the requirements class defined in Clause 7 a more fine-grain interpolation specification per axis will be added; the representation in this UML diagram has been prepared for this, explaining why it could be simplified theoretically. Further, the pertaining XML Schema of this Interpolation Extension contains all variants.

Requirement 5 interpolation/GetCoverage-request:
A *GetCoverage* request **SHALL** adhere to Figure 2, Table 3, and the XML schema defined for this Interpolation Extension.

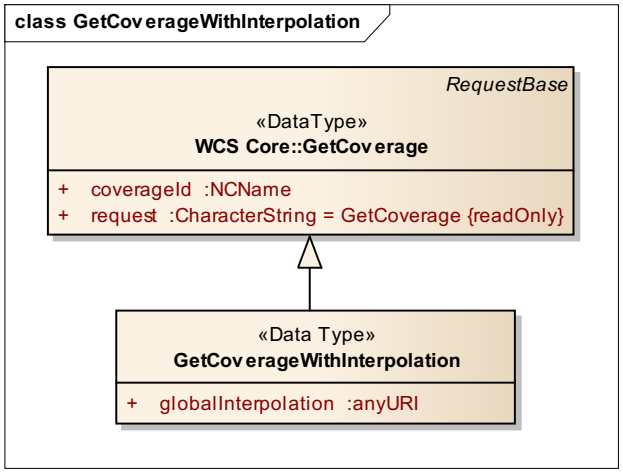

Figure 2 — `GetCoverage` with *interpolation* support UML diagram

Table 4 — Components of `Int::InterpolationMethod` structure

Name	Definition	Data type	Multiplicity
`globalInterpolation`	Interpolation method to be applied on all axes during *GetCoverage* result preparation	`anyURI`	Zero or one (optional)

6.4.2 Modifications to the *GetCoverage* response

Interpolation affects the result of *GetCoverage* in some clearly defined situations, namely slicing, scaling and CRS transformation. In all other cases, no interpolation is applied and the `globalInterpolation` parameter has no effect.

The `globalInterpolation` parameter is optional. If omitted the server is free to choose some interpolation method, as if the extension is not implemented.

If the *GetCoverage* request contains slicing along one or more axes and the slice points coincide with direct positions then the behaviour is identical to the WCS Core behavior. In addition to slicing at direct positions, it is possible to also slice at positions in the neighbourhood of direct positions. In this case, for each such position the range values are obtained by applying the selected interpolation method.

Requirement 6 interpolation/GetCoverage-response-slicing:
The contents of the response to a successful *GetCoverage* request containing one or more slicing operations where the slice points do not coincide with direct positions but are situated in a neighborhood of direct positions **SHALL** be obtained by computing range values for the non-direct positions through interpolation. The interpolation method to be applied is governed by the requirements specified in the WCS Interpolation Standard.

Note The definition of neighborhood is outside the scope of this Standard. It is expected that the Coverage Implementation Schema will be enhanced with a field of validity concept for expressing allowed neighborhoods. Depending on such a definition, the neighborhood may stretch some distance beyond the outermost direct position of a coverage, i.e., beyond its minimum bounding box.

The `globalInterpolation` parameter can be used to enforce application of some particular interpolation method.

Requirement 7 interpolation/GetCoverage-response:
The contents of the response to a successful *GetCoverage* request containing an `Int::globalInterpolation` parameter with value *m* **SHALL** be obtained by applying interpolation method *m* any time interpolation takes place during preparation of the response, and along every axis of the coverage being processed.

Requirement 8 interpolation/GetCoverage-admissible-interpolation:
In a *GetCoverage* request, if an `Int::globalInterpolation` parameter is provided then this **SHALL** be one of the interpolation methods listed in the coverage addressed.

Note This interpolation is applied uniformly along all axes of the coverages.

6.5 Exceptions

Table 5 — Exception codes for use of `Interpolation`

`exceptionCode` value	**HTTP code**	**Meaning of exception code**	**`locator` value**
`InterpolationMethodNotSupported`	404	`interpolation` parameter indicated is not supported by this server (i.e., URL is not known to this server)	`interpolation` request parameter value

6.6 Encodings

6.6.1 GET/KVP Encoding

Requirement 9 interpolation/GetCoverage-getkvp:
In a *GetCoverage* request using the GET/KVP protocol as specified in WCS KVP Protocol Binding Extension [OGC 09-147r3] (or a later version), an `Int::globalInterpolation` parameter **SHALL** be represented as

```
INTERPOLATION=m
```

where `m` is an interpolation method identifier.

Example The following KVP fragment resembles a valid interpolation request parameter:

```
…& INTERPOLATION=
   http://www.opengis.net/def/interpolation/OGC/1/linear &…
```

6.6.2 XML/POST Encoding

Requirement 10 interpolation/GetCoverage-xmlpost:
In a *GetCoverage* request using the XML/POST protocol as specified in WCS XML/POST Protocol Binding Extension [OGC 09-148r1], an `Int::globalInterpolation` parameter **SHALL** be represented by a GML `int:globalInterpolation` element.

Example The XML fragments below resemble the same example cases as the GET/KVP fragment above.

```
<int:Interpolation>
    <int:globalInterpolation>
        http://www.opengis.net/def/interpolation/OGC/1/linear
    </int:globalInterpolation/>
</int:Interpolation>
```

6.6.3 SOAP Encoding

Requirement 11 interpolation/GetCoverage-soap:
In a *GetCoverage* request using the SOAP protocol, an `Int::globalInterpolation` parameter **SHALL** be represented by a GML `int:globalInterpolation` element.

Example See previous subclause.

7 *Interpolation-per-axis* requirements class

7.1 Overview

This Clause establishes the optional Interpolation Extension requirements class, *interpolation-per-axis*. This requirements class specifies how to request and obtain coverages where individual interpolation modes can be applied independently to each axis of the coverage under processing. For those axes where no interpolation is specified in the *interpolation-per-axis* structures, the default interpolation method passed in the core parameter, `Int::globalInterpolation`, applies.

7.2 Modifications to *GetCapabilities*

Requirement 12 interpolation-per-axis/identifier:
A WCS service implementing requirements class *interpolation-per-axis* of this Interpolation Extension **SHALL** include the following URI in the `Profile` element of the `ServiceIdentification` in a *GetCapabilities* response:
`http://www.opengis.net/spec/WCS_service-extension_interpolation/1.0/conf/interpolation-per-axis`

7.3 Modifications to *DescribeCoverage*

None.

7.4 Modifications to *GetCoverage*

7.4.1 Modifications to the *GetCoverage* request

Requirement 13 interpolation-per-axis/getCoverage-request:
The `Int::InterpolationPerAxis` parameter in a *GetCoverage* request, if present, **SHALL** have a structure as defined in Figure 3 and Table 6.
Dependency:
Clause 6, http://www.opengis.net/doc/IS/WCS_service-extension_interpolation/1.0/Clause-6

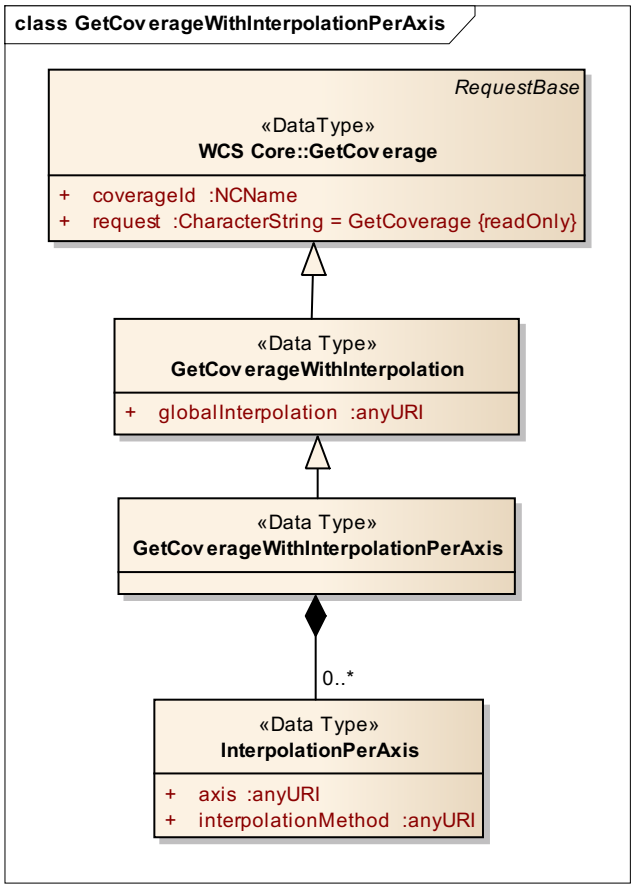

Figure 3 — `GetCoverage` with *interpolation-per-axis* support UML diagram

Individually for each axis of the coverage, separate interpolation methods can be indicated.

Requirement 14 interpolation-per-axis/getCoverage-axes:
The `Int::InterpolationPerAxis` parameters in a *GetCoverage* request, if present, **SHALL** consist of an unordered sequence of `Int::InterpolationPerAxis` elements with a structure as defined in Table 6.

Table 6 — Components of `Int::InterpolationAxis` structure

Name	Definition	Data type	Multiplicity
`axis`	Coverage axis along which the interpolation method is to be applied	`anyURI`	one (mandatory)
`Interpolation-Method`	Interpolation method to be applied along the specified axis during *GetCoverage* result preparation	`anyURI`	one (mandatory)

Each axis in the CRS of the coverage can appear at most once, to avoid ambiguities.

Requirement 15 interpolation-per-axis/getCoverage-axes-pairwise-distinct:
In a *GetCoverage* request containing `Int::InterpolationPerAxis` parameters, all `axis` values **SHALL** be pairwise distinct.

Requirement 16 interpolation-per-axis/getCoverage-existing-axis:
The `axis` value of each `Int::InterpolationPerAxis` parameter in a *GetCoverage* request **SHALL** be identical to the `axisAbbrev` element of some CRS axis of the CRS identified by the `srsName` attribute in the `gml:Envelope` element of the coverage generated.

Note Interpolation always is done towards a target structure (such as an output grid). In presence of an `OUTPUTCRS` parameter according to the WCS CRS Extension [OGC 11-053]. Therefore, interpolation has to be expressed on the axes of the CRS indicated in `OUTPUTCRS`. Otherwise, the coverage's Native CRS is used.

7.4.2 Modifications to the *GetCoverage* response

Requirement 17 interpolation-per-axis/getCoverage-response:
The contents of the response to a successful *GetCoverage* request containing $n>0$ `Int::InterpolationPerAxis` parameters consisting of $a_1,\ldots,a_n$ axis identifiers and $m_1,\ldots,m_n$ interpolation methods **SHALL** be obtained by applying interpolation method m_i on axis a_i any time interpolation takes place during preparation of the *GetCoverage* response; for those axes not appearing in this list, the method indicated in the `int:globalInterpolation` parameter **SHALL** be applied.

Example The following is a valid GET/KVP request snippet (see Subclause 7.6) specifying that in general (such as lat, long, height, or whatever axis is present in the coverage) linear interpolation is to be applied, only along the time axis nearest-neighbor is requested (assuming the coverage addressed contains such a temporal axis):

```
…& INTERPOLATION=
   https://www.opengis.net/def/interpolation/OGC/1/linear
```



```
& INTERPOLATIONPERAXIS=phenomenon-time,
  https://www.opengis.net/def/interpolation/OGC/1/nearest-neighbor
&…
```

7.5 Exceptions

Table 7 — Exception codes for use of `InterpolationPerAxis`

`exceptionCode` value	HTTP code	Meaning of exception code	`locator` value
`NoSuchAxis`	404	One or more axis names indicated in the request are not defined in the domain of the output coverage	`axis` request parameter value
`InterpolationMethodNotSupported`	404	One or more interpolation methods indicated in the request are not supported by this server	first offending `interpolation` request parameter value

7.6 Encodings

7.6.1 GET/KVP Encoding

Requirement 18 interpolation-per-axis/getCoverage-getkvp:
In a *GetCoverage* request using the GET/KVP protocol as specified in WCS GET/KVP Protocol Binding Extension [OGC 09-147r2], an `Int::Interpolation` parameter containing n>0 (`Int::axis, Int::interpolationMethod`) components (a_1:m_1),…,(a_n:m_n) **SHALL** be represented as

```
INTERPOLATIONPERAXIS=a1,m1
& …
& INTERPOLATIONPERAXIS=an,mn
```

Example The following KVP fragment resembles a valid interpolation request:

```
…& INTERPOLATION=
   https://www.opengis.net/def/interpolation/OGC/1/linear
 & INTERPOLATIONPERAXIS=lat,
   https://www.opengis.net/def/interpolation/OGC/1/quadratic
 & INTERPOLATIONPERAXIS=long,
   https://www.opengis.net/def/interpolation/OGC/1/quadratic
 & INTERPOLATIONPERAXIS=height,
   https://www.opengis.net/def/interpolation/OGC/1/cubic
 & INTERPOLATIONPERAXIS=phenomenon-time,
   https://www.opengis.net/def/interpolation/OGC/1/nearest-neighbor
 &…
```

7.6.2 XML/POST Encoding

Requirement 19 interpolation-per-axis/getCoverage-xmlpost:
In a *GetCoverage* request using the XML/POST protocol as specified in WCS XML/POST Protocol Binding Extension [OGC 09-148r1], the `Int::InterpolationPerAxis`

parameters, if present, **SHALL** be represented by GML `int:InterpolationPerAxis` elements.

Example The XML fragments below resemble the same example cases as the GET/KVP fragment above.

```
<int:Interpolation>
    <int:globalInterpolation>
       https://www.opengis.net/def/interpolation/OGC/1/linear
    </int:globalInterpolation>
    <int:InterpolationPerAxis>
        <int:axis>lat</int:axis>
        <int:interpolationMethod>
            https://www.opengis.net/def/interpolation/OGC/1/quadratic
        </int:interpolationMethod>
    </int:InterpolationPerAxis>
    <int:InterpolationPerAxis>
        <int:axis>long</int:axis>
        <int:interpolationMethod>
            https://www.opengis.net/def/interpolation/OGC/1/quadratic
        </int:interpolationMethod>
    </int:InterpolationPerAxis>
    <int:InterpolationPerAxis>
        <int:axis>height</int:axis>
        <int:interpolationMethod>
            https://www.opengis.net/def/interpolation/OGC/1/cubic
        </int:interpolationMethod>
    </int:InterpolationPerAxis>
    <int:InterpolationPerAxis>
        <int:axis>phenomenon-time</int:axis>
        <int:interpolationMethod>
            https://www.opengis.net/def/interpolation/OGC/1/nearest-
neighbor
        </int:interpolationMethod>
    </int:InterpolationPerAxis>
</int:Interpolation>
```

7.6.3 SOAP Encoding

Requirement 20 interpolation-per-axis/getCoverage-soap:
In a *GetCoverage* request using the SOAP protocol as specified in WCS SOAP Protocol Binding Extension [OGC 09-149r1], the `int::InterpolationPerAxis` parameters, if present, **SHALL** be represented by GML `int:InterpolationPerAxis` elements.

Example See previous subclause.

Bibliography

[1] OGC 07-011r2, Ab*stract Specification Topic 6.1: Schema for Coverage Geometry and Functions – Part 1: Fundamentals*, version 2.0 (identical to ISO 19123-1:2023)

[2] A. Whiteside, J. Greenwood (eds.): OGC Web Services Common Implementation Specification, version 2.0.0, OGC 06-121r9, https://portal.ogc.org/files/?artifact_id=38867

Annex A
(normative)

Abstract test suite

An implementation of the WCS Interpolation Extension must satisfy the following system characteristics to be conformant with this Standard.

Test identifiers below are relative to https://www.opengis.net/spec/WCS/2.0/WCS_service-extension_interpolation/1.0/conf.

A.1 Conformance Test Class: *interpolation*

The OGC URI identifier of this conformance class is:
https://www.opengis.net/spec/WCS/2.0/conf/WCS_service-extension_interpolation/1.0/conf/interpolation.

A.1.1 Interpolation/interpolation identifier

Test id: **interpolation/interpolation-identifier:**
Test Purpose: A WCS service implementing conformance class *interpolation* of the Interpolation Extension **SHALL** include the following URI in the `Profile` element of the `ServiceIdentification` in a *GetCapabilities* response:
`http://www.opengis.net/spec/WCS_service-extension_interpolation/1.1/conf/interpolation`

Test method: Send a *GetCapabilities* request to server under test, verify that the response contains a `Profile` element with said URI.

Test passes if result is as expected.

A.1.2 Interpolation/capabilities

Test id: **interpolation/capabilities:**
Test Purpose: The response to a successful *GetCapabilities* request **SHALL** adhere to Figure 1, Table 2, and the XML schema defined for this Interpolation Extension.

Test method: Send a *GetCapabilities* to server under test, and check for proper response.

Test passes if result is as expected.

A.1.3 Interpolation/wcs ServiceMetadata

Test id: **interpolation/wcsServiceMetadata:**
Test Purpose: The response to a successful *GetCapabilities* request **SHALL** contain an `InterpolationMetadata` element.

Test method: Send a *GetCapabilities* request to server under test, verify that the response contains an `InterpolationMetadata` element.

Test passes if result is as expected.

A.1.4 Interpolation/wcs ServiceMetadata interpolation Methods

Test id: **interpolation/wcsServiceMetadata-interpolationMethods:**
Test Purpose: The `interpolationSupported` item(s) delivered in the `ServiceMetadata` element of the response to a successful *GetCapabilities* request **SHALL** consist of a pairwise distinct list of URLs.

Test method: Send a *GetCapabilities* request to server under test, check that the `interpolationSupported` item(s) of the response consist of a pairwise distinct list of URLs.

Test passes if result is as expected.

A.1.5 Interpolation/interpolation GetCoverage request

Test id: **interpolation/GetCoverage-request:**
Test Purpose: A *GetCoverage* request **SHALL** adhere to Figure 2, Table 3, and the XML schema defined for this Interpolation Extension.

Test method: Send *GetCoverage* requests testing server response on the cases distinguished in said reference. Check for proper response.

Test passes if expected result is delivered.

A.1.6 Interpolation/interpolation GetCoverage response slicing

Test id: **interpolation/GetCoverage-response-slicing:**
Test Purpose: The contents of the response to a successful *GetCoverage* request containing one or more slicing operations where the slice points do not coincide with direct positions but are situated in a neighborhood of direct positions **SHALL** be obtained by computing range values for the non-direct positions through interpolation. The interpolation method to be applied is governed by the requirements specified in the WCS Interpolation Standard.

Test method: Send a *GetCoverage* request to the service under test containing one or more slicing operations where the slice points do not coincide with direct positions but are situated in a neighborhood of direct positions, verify that the result is obtained by computing range values for the non-direct positions through interpolation, whereby the interpolation method to be applied is governed by this WCS-Interpolation standard.

Test passes if expected result is delivered.

A.1.7 Interpolation/interpolation GetCoverage response

Test id: **interpolation/GetCoverage-response:**
Test Purpose: The contents of the response to a successful *GetCoverage* request containing an `Int::globalInterpolation` parameter with value *m* **SHALL** be obtained by applying interpolation method *m* any time interpolation takes place during preparation of the response, and along every axis of the coverage being processed.

Test method: Send a *GetCoverage* request containing an `int::globalInterpolation` parameter to server under test, verify that the response is not an exception.

Test passes if result is as expected.

A.1.8 Interpolation/interpolation GetCoverage admissible interpolation

Test id: **interpolation/GetCoverage-admissible-interpolation:**
Test Purpose: In a *GetCoverage* request, if an `Int::globalInterpolation` parameter is provided then this **SHALL** be one of the interpolation methods listed in the coverage addressed.

Test method: Send a *GetCoverage* request containing an `int::globalInterpolation` parameter with its value set to one of the interpolation methods listed in the coverage addressed, verify that the response is not an exception.

Test passes if result is as expected.

A.1.9 Interpolation/interpolation per axis GetCoverage getkvp

Test id: **interpolation/GetCoverage-getkvp:**
Test Purpose: In a *GetCoverage* request using the GET/KVP protocol as specified in WCS KVP Protocol Binding Extension [OGC 09-147r3] (or a later version), an `Int::globalInterpolation` parameter **SHALL** be represented as

```
INTERPOLATION=m
```

where `m` is an interpolation method identifier.

Test method: Send a Get/KVP *GetCoverage* request containing an `int::globalInterpolation` parameter represented as

`INTERPOLATION=m` to server under test, verify that the response is not an exception.

Test passes if result is as expected.

A.1.10 Interpolation/interpolation per axis GetCoverage xmlpost

Test id: **interpolation/GetCoverage-xmlpost:**
Test Purpose: In a *GetCoverage* request using the XML/POST protocol as specified in WCS XML/POST Protocol Binding Extension [OGC 09-148r1], an `Int::globalInterpolation` parameter **SHALL** be represented by a GML `int:globalInterpolation` element.

Test method: Send a XML/POST *GetCoverage* request containing an `Interpolation::InterpolationMethod` parameter represented by an `int::InterpolationMethod` element, verify that the response is not an exception.

Test passes if result is as expected.

A.1.11 Interpolation/interpolation per axis GetCoverage soap

Test id: **interpolation/GetCoverage-soap:**
Test Purpose: In a *GetCoverage* request using the SOAP protocol, an `Int::globalInterpolation` parameter **SHALL** be represented by a GML `int:globalInterpolation` element.

Test method: Send a SOAP *GetCoverage* request containing an `Interpolation::InterpolationMethod` parameter represented by an `int::InterpolationMethod` element, verify that the response is not an exception.

Test passes if result is as expected.

A.1.12 Interpolation-per-axis/identifier

Test id: **interpolation-per-axis/identifier:**
Test Purpose: A WCS service implementing requirements class *interpolation-per-axis* of this Interpolation Extension **SHALL** include the following URI in the `Profile` element of the `ServiceIdentification` in a *GetCapabilities* response:
`http://www.opengis.net/spec/WCS_service-extension_interpolation/1.0/conf/interpolation-per-axis`

Test method: Send a *GetCapabilities* request to server under test, verify that the response contains a `Profile` element with said URI.

Test passes if result is as expected.

A.1.13 Interpolation-per-axis/getCoverage request

Test id: **interpolation-per-axis/getCoverage-request:**
Test Purpose: The `Int::InterpolationPerAxis` parameter in a *GetCoverage* request, if present, **SHALL** have a structure as defined in Figure 3 and Table 6.
Dependency:
Clause 6, http://www.opengis.net/doc/IS/WCS_service-extension_interpolation/1.0/Clause-6

Test method: Send *GetCoverage* requests testing server response on the cases distinguished in said reference, and check for proper response.

Test passes if expected result is delivered.

A.1.14 Interpolation-per-axis/getCoverage axes

Test id: **interpolation-per-axis/getCoverage-axes:**
Test Purpose: The `Int::InterpolationPerAxis` parameters in a *GetCoverage* request, if present, **SHALL** consist of an unordered sequence of `Int::InterpolationPerAxis` elements with a structure as defined in Table 6.

Test method: Send *GetCoverage* requests testing server response on the cases distinguished in said reference, and check for proper response.

Test passes if expected result is delivered.

A.1.15 Interpolation-per-axis/getCoverage-axes-pairwise-distinct

Test id: **interpolation-per-axis/getCoverage-axes-pairwise-distinct:**
Test Purpose: In a *GetCoverage* request containing `Int::InterpolationPerAxis` parameters, all `axis` values **SHALL** be pairwise distinct.

Test method: Send *GetCoverage* requests to the service under test containing:

- two `int::InterpolationPerAxis` elements with different axis names. Verify that request succeeds.
- two `int::InterpolationPerAxis` elements with identical axis names. Verify that request fails.

Test passes if expected result is delivered.

A.1.16 Interpolation-per-axis/getCoverage existing axis

Test id: The `axis` value of each `Int::InterpolationPerAxis` parameter in a
Test Purpose: *GetCoverage* request **SHALL** be identical to the `axisAbbrev` element of some CRS axis of the CRS identified by the `srsName` attribute in the `gml:Envelope` element of the coverage generated.

Test method: Send *GetCoverage* requests to the service under test, with an `Interpolation::InterpolationAxis` parameter contains an `axis` element which is:

- identical to the identifier of a domain axis in the coverage addressed. Verify that request succeeds.
- not identical to any domain axis identifier in the coverage addressed. Verify that request fails.

Test passes if expected result is delivered.

A.1.17 Interpolation-per-axis/getCoverage response

Test id: **interpolation-per-axis/getCoverage-response:**
Test Purpose: The contents of the response to a successful *GetCoverage* request containing n>0 `Int::InterpolationPerAxis` parameters consisting of $a_1,\ldots,a_n$ axis identifiers and $m_1,\ldots,m_n$ interpolation methods **SHALL** be obtained by applying interpolation method m_i on axis a_i any time interpolation takes place during preparation of the *GetCoverage* response; for those axes not appearing in this list, the method indicated in the `int:globalInterpolation` parameter **SHALL** be applied.

Test method: Send a *GetCoverage* request containing, an `Interpolation::InterpolationAxes` parameter with n>0 `Interpolation::InterpolationAxis` components consisting of $a_1,\ldots,a_n$ axis identifiers and $m_1,\ldots,m_n$ interpolation method, check that response is correct.

Test passes if result is as expected.

A.1.18 Interpolation-per-axis/getCoverage getkvp

Test id: **interpolation-per-axis/getCoverage-getkvp:**
Test Purpose: In a *GetCoverage* request using the GET/KVP protocol as specified in WCS GET/KVP Protocol Binding Extension [OGC 09-147r2], an `Int::Interpolation` parameter containing n>0 (`Int::axis`, `Int::interpolationMethod`) components (a_1:m_1),…,(a_n:m_n) **SHALL** be represented as

INTERPOLATIONPERAXIS=a_1,m_1

& …
& INTERPOLATIONPERAXIS=a_n,m_n

Test method: Send a GET/KVP *GetCoverage* request containing an `Int::Interpolation` parameter containing n>0 `Int::InterpolationAxis` components represented as `INTERPOLATIONPERAXIS` =a_1:m_1,…,a_n:m_n, where each a_i is an axis identifier URL and each m_i is an interpolation identifier URL, verify that the response is not an exception.

Test passes if result is as expected.

A.1.19 Interpolation-per-axis/getCoverage xmlpost

Test id: **interpolation-per-axis/getCoverage-xmlpost:**
Test Purpose: In a *GetCoverage* request using the XML/POST protocol as specified in WCS XML/POST Protocol Binding Extension [OGC 09-148r1], the `Int::InterpolationPerAxis` parameters, if present, **SHALL** be represented by GML `int:InterpolationPerAxis` elements.

Test method: Send a valid XML/POST *GetCoverage* request containing `int:: InterpolationPerAxis` elements, verify that the response is not an exception.

Test passes if result is as expected.

A.1.20 Interpolation-per-axis/getCoverage-soap

Test id: **interpolation-per-axis/getCoverage-soap:**
Test Purpose: In a *GetCoverage* request using the SOAP protocol as specified in WCS SOAP Protocol Binding Extension [OGC 09-149r1], the `int::InterpolationPerAxis` parameters, if present, **SHALL** be represented by GML `int:InterpolationPerAxis` elements.

Test method: Send a SOAP *GetCoverage* request containing `int::Interpolation` elements, verify that the response is not an exception.

Test passes if result is as expected.

-- end of ATS –

Annex B
(informative)

Revision History

Date	Release	Author	Paragraph modified	Description
2012-06-20	0.0.1	Peter Baumann	All	Created
2012-08-12	0.0.2	Peter Baumann	All	Formalized requirements
2012-12-03	0.1.0	Peter Baumann, JinosngdiYu	Several, in particular: Annex A	Completed, added ATS
2014-01-01	1.0.0	Peter Baumann, Jinsongdi Yu	All	Finalized after adoption vote; removed interpolation method URL definition, as this is now supposed to be done by OGC-NA
2024-06-17	1.1.0	Peter Baumann, Jinsongdi Yu	Several	Added slicing interpolation support, and ATS updated accordingly
2024-11-19	1.1.0	Peter Baumann	several Table 4	Document references updated Made parameter optional
2025-02-11	1.1.0	Peter Baumann	several	Addressed C Reed comments

