OGC API - Features - Part 2

Extension for Coordinate Reference Systems by Reference

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OGC API - Features - Part 2: Extension for Coordinate Reference Systems by Reference

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i. Abstract

OGC API standards define modular API building blocks to spatially enable Web APIs in a consistent way. The OpenAPI specification is used to define the API building blocks.

OGC API Features provides API building blocks to create, modify and query features on the Web. OGC API Features is comprised of multiple parts, each of them is a separate standard.

This part extends the core capabilities specified in Part 1: Core with the ability to use coordinate reference system identifiers other than the defaults defined in the core.

CAUTION	This is a DRAFT version of the nth part of the OGC API - Features standards. This draft is not complete and there are open issues that are still under discussion.

ii. Keywords

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

coordinate reference system identifier CRS feature spatial data openapi crs84 wgs84 longitude latitude

iii. Preface

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iv. Submitting organizations

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

- CubeWerx Inc.
- Hexagon
- interactive instruments GmbH
- Planet Labs

v. Submitters

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

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Clemens Portele *(editor)*	interactive instruments GmbH
Frédéric Houbie	Hexagon

Panagiotis (Peter) A. Vretanos *(editor)*	CubeWerx Inc.

Chapter 1. Scope

This document specifies an extension to the OGC API - Features - Part 1: Core standard that defines the behaviour of a server that supports multiple coordinates reference systems.

This document assumes that each supported coordinate reference system can be referenced by a unique resource identifier (i.e. a URI).

Specifically, this document specifies:

- How, for each offered feature collection, a server advertises the list of supported coordinate reference system identifiers.
- How the coordinates of geometry valued feature properties can be accessed in one of the supported coordinate reference systems.
- How features can be accesses from the server using a bounding box specified in one of the supported coordinate reference systems.
- How a server can declare the coordinate reference system used to present feature resources, and optionally the axis order of coordinates used.

Chapter 2. Conformance

This standard defines one requirements / conformance class Coordinate Reference Systems by Reference. The standardization target is "Web APIs".

Conformance with this standard shall be checked using all the relevant tests specified in Annex A 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.

Chapter 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.

- Portele, C., Vretanos, P.: OGC 17-069r2, **OGC API - Features - Part 1: Core**, http://example.com/fixme
- Reed C., OGC 08-038r7, **Revision to Axis Order Policy and Recommendations**, https://portal.opengeospatial.org/files/?artifact_id=76024
- van den Brink, L., Portele, C., Vretanos, P.: OGC 10-100r3, Geography Markup Language (GML) Simple Features Profile*, http://portal.opengeospatial.org/files/?artifact_id=42729
- Butler, H., Daly, M., Doyle, A., Gillies, S., Hagen, S., Schaub, T.: IETF RFC 7946, **The GeoJSON Format**, https://tools.ietf.org/rfc/rfc7946.txt
- W3C: **HTML5**, W3C Recommendation, http://www.w3.org/TR/html5/

Chapter 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, the following additional terms and definitions apply in addition to the terms defined in OGC API - Features - Part 1: Core.

4.1. coordinate

one of a sequence of n numbers designating the position of a point in n-dimensional space [ISO 19111:2007, definition 4.5]

4.2. coordinate reference system

coordinate system (4.5) that is related to an object by a datum [ISO 19111:2007, definition 4.8]

4.3. coordinate system

set of mathematical rules for specifying how coordinates are to be assigned to points [ISO 19111:2007, definition 4.10]

4.4. feature

abstraction of real world phenomena [ISO 19101-1:2014]

NOTE	If you are unfamiliar with the term 'feature', the explanations in the W3C/OGC Spatial Data on the Web Best Practice document may help, in particular the section on Spatial Things, Features and Geometry.

4.5. feature collection; collection

a set of **features** from a **dataset**

NOTE	In this specification, 'collection' is used as a synonym for 'feature collection'. This is done to make, for example, URI path expressions shorter and easier to understand for those that are not geo-experts.

4.6. spatial feature collection; spatial collection

a feature collection that includes one or more geometry-valued properties

Chapter 5. Conventions and background

See OGC API - Features - Part 1: Core, Clauses 5 and 6.

Chapter 6. Requirements Class Coordinate Reference Systems by Reference

6.1. Overview

Requirements Class	
http://www.opengis.net/spec/ogcapi-features-2/1.0/req/crs	
Target type	Web API
Dependency	OGC API - Features - Part 1: Core, Conformance Class 'core'

The OGC API - Features - Part 1: Core standard defines support for only two coordinate reference systems:

- WGS 84 longitude/latitude
- WGS 84 longitude/latitude plus ellipsoidal height

This extensions defines the behaviour of a server that supports additional coordinate reference systems.

6.2. Discovery

6.2.1. CRS identifier list

Requirement 1	/req/crs/fc-md-crs-list For each spatial feature collection offered by a server, the 'crs' property in the feature collection metadata shall contain the list of CRS identifiers supported by the service for this collection.

Requirement 2	/req/crs/fc-md-crs-list-defaultCrs The default CRS — that is the CRS used unless something else is explicitly requested — shall be as defined in OGC API - Features - Part 1: Core: • http://www.opengis.net/def/crs/OGC/1.3/CRS84 (for coordinates without height) • http://www.opengis.net/def/crs/OGC/0/CRS84h (for coordinate with height)

The list of supported CRS identifiers may include these defaults but this is not a requirement.

6.2.2. Storage CRS

The storage CRS for a feature collection is the CRS identifier that may be used to retrieve features from the server without the need to apply a CRS transformation.

include::requirements/crs/REQ_fc-md-storageCrs.adoc

6.2.3. Global list of CRS identifiers

To prevent unnecessary duplication of lists of supported CRS identifiers in the collections metadata, a global list of supported CRS identifiers may be provided as part of the feature collections metadata.

This global list of CRS identifiers may be referenced in the collection metadate using a JSON link.

Requirement 3	/rec/crs/fc-md-crs-list-global
	
	If referenced in the collection metadata, then all CRS identifiers in the global list shall be valid for the referencing collection.
	
	The following schema fragment extends the collections metadata from OAPIF core to add the `crs` property which is the global list of CRS identifiers.
	
	`type: object`
	`required:`
	`  - links`
	`  - collections`
	`properties:`
	`  links:`
	`    type: array`
	`    items:`
	`      $ref: link.yaml`
	`  crs:`
	`    description: the list of CRS identifiers that are supported by the service; the CRS identifiers in this list shall be valid for all spatial feature collections offered by the service`
	`    type: array`
	`    items:`
	`      type: string`
	`      format: uri`
	`  collections:`
	`    type: array`
	`    items:`
	`      $ref: collection.yaml`

The following example illustrates the used of a global list of CRS identifiers.

Example 1. Collections metadata containing a global list of CRS identifiers

```
{
  "links": [
    { "href": "http://data.example.org/collections.json",
      "rel": "self", "type": "application/json", "title": "this document" },
    { "href": "http://data.example.org/collections.html",
      "rel": "alternate", "type": "text/html", "title": "this document as HTML" },
    { "href": "http://schemas.example.org/1.0/buildings.xsd",
      "rel": "describedBy", "type": "application/xml", "title": "GML application
schema for Acme Corporation building data" },
    { "href": "http://download.example.org/buildings.gpkg",
      "rel": "enclosure", "type": "application/geopackage+sqlite3", "title": "Bulk
download (GeoPackage)", "length": 472546 }
  ],
  "crs": [
     "http://www.opengis.net/def/crs/EPSG/0/4326",
     "http://www.opengis.net/def/crs/EPSG/0/3857",
     "http://www.opengis.net/def/crs/EPSG/0/3395",
     "http://www.opengis.net/def/crs/EPSG/0/4267",
     "http://www.opengis.net/def/crs/EPSG/0/4269",
     "http://www.opengis.net/def/crs/EPSG/0/26716",
     "http://www.opengis.net/def/crs/EPSG/0/26717",
     "http://www.opengis.net/def/crs/EPSG/0/26718",
     "http://www.opengis.net/def/crs/EPSG/0/26719",
     "http://www.opengis.net/def/crs/EPSG/0/26916",
     "http://www.opengis.net/def/crs/EPSG/0/26917",
     "http://www.opengis.net/def/crs/EPSG/0/26918",
     "http://www.opengis.net/def/crs/EPSG/0/26919",
     "http://www.opengis.net/def/crs/EPSG/0/32616",
     "http://www.opengis.net/def/crs/EPSG/0/32617",
     "http://www.opengis.net/def/crs/EPSG/0/32618",
     "http://www.opengis.net/def/crs/EPSG/0/32619",
     "http://www.opengis.net/def/crs/EPSG/0/32188"
  ],
  "collections": [
     {
       "id": "buildings",
       "title": "Buildings",
       "description": "Buildings in the city of Bonn.",
       "extent": {
         "spatial": {
           "bbox": [ [ 7.01, 50.63, 7.22, 50.78 ] ]
         },
         "temporal": {
           "interval": [ [ "2010-02-15T12:34:56Z", null ] ]
         }
       },
       "links": [
         { "href": "http://data.example.org/collections/buildings/items",
```

```
          "rel": "items", "type": "application/geo+json",
          "title": "Buildings" },
        { "href": "https://creativecommons.org/publicdomain/zero/1.0/",
          "rel": "license", "type": "text/html",
          "title": "CC0-1.0" },
        { "href": "https://creativecommons.org/publicdomain/zero/1.0/rdf",
          "rel": "license", "type": "application/rdf+xml",
          "title": "CC0-1.0" }
      ],
      "crs": [
         #/crs,
         "http://www.opengis.net/def/crs/OGC/1.3/CRS41001",
         "http://www.opengis.net/def/crs/CUBEWERX/0/42101",
         "http://www.opengis.net/def/crs/CUBEWERX/0/42103",
         "http://www.opengis.net/def/crs/CUBEWERX/0/42105",
         "http://www.opengis.net/def/crs/ESRI/0/102002",
      ]
    }
  ]
}
```

6.2.4. CRS identifier format

Requirement 4	/req/crs/crs-format-model Servers that implement this extension shall handle CRS identifiers with the following format model: http://www.opengis.net/def/crs/{authority}/{version}/{code} In this format model, the token {authority} is a placeholder for a code the designates to authority responsible for the definition of this CRS. Typical values include "epsg" and "ogc". The token {version} is a placeholder for the specific version of the coordinate reference system definition or `0` for the latest version or if the version is unknown. The token {code} is a placeholder for the authority's code for the CRS.

Other formats may be supported as well but they are not described in this standard.

6.3. Query

6.3.1. Parameter bbox-crs

The `bbox-crs` parameter may be used to assert the CRS used for the coordinate values of the `bbox` parameter.

Requirement 5	/req/core/fc-bbox-crs-definition
	
	Each feature collection operation shall support a parameter `bbox-crs` with the following characteristics (using an OpenAPI Specification 3.0 fragment):
	
	`name: bbox-crs`
	`in: query`
	`required: false`
	`schema:`
	`  type: string`
	`  format: uri`
	`style: form`
	`explode: false`

Requirement 6	/req/core/fc-bbox-crs-valid-value If specified, the value of the `bbox-crs` parameter shall be taken from the list of supported CRS identifiers as declared in the metadata for each spatial feature collection.
Requirement 7	/req/core/fc-bbox-crs-valid-defaultValue If the `bbox-crs` parameter is not specified then the values of the `bbox` parameter shall be assumed to be in the default WGS84 (lon,lat) coordinate reference system (i.e. http://www.opengis.net/def/crs/OGC/1.3/CRS84).
Requirement 8	/req/core/fc-bbox-crs-action If the `bbox-crs` parameter is specified then the values of the bbox parameter shall be assumed to be in the specified CRS and the server shall perform the necessary internal transformations to properly fetch data from within the specified bounding box.

Requirement 9	/req/crs/crs-exception In all cases, an invalid or unrecognized coordinate reference system value shall trigger a 400 exception with an appropaite message.

The following fragment illustrates the use of the `bbox-crs` parmeter:

Example 2. Specifying a bounding box in one of the supported coordinate reference systems

```
...&bbox=160.6,-155.95,-170,-25.89&bbox-crs=http://www.opengis.net/...
```

6.3.2. Parameter crs

Requirement 10	/req/core/fc-crs-definition
	
	Each spatial feature collection operation shall support a parameter named `crs` with the following characteristics (using an OpenAPI Specification 3.0 fragment):
	
	`name: crs`
	`in: query`
	`required: false`
	`schema:`
	`  type: string`
	`  format: uri`
	`style: form`
	`explode: false`

Requirement 11	/req/core/fc-crs-valid-value If specified, the value of the `crs` parameter shall be taken from the list of supported list of coordinate reference systems as declared in the metadata for each feature collection.

Requirement 12	/req/core/fc-crs-default-value If the `crs` parameter is not specified the geometry coordinates shall be presented in the default CRS specified in OGC API - Feature - Part 1: Core (i.e. http://www.opengis.net/def/crs/OGC/1.3/CRS84 or http://www.opengis.net/def/crs/OGC/0/CRS84h).

Requirement 13	/req/core/fc-crs-action If the `crs` parameter is specified then the coordinates of all geometry-valued properties in the response document shall be presented in the requested CRS subject to any limitations placed on the response based on the requested output representation (e.g. the requested representation mandates a fixed CRS).

Requirement 14	/req/core/fc-crs-action-exception If the requested `crs` parameter values violates some requirement of the requested output format then the server shall raise an 400 exception with an appropriate message.

Requirement 15	/req/crs/crs-exception An invalid or unrecognized `crs` value shall trigger a 400 exception with an appropriate message.

The following fragment illustrated the use of the `crs` parameter:

Example 3. Retrieving features from a collection is one of the supported coordinate reference systems

```
.../collections/buildings/items?crs=http://www.opengis.net/def/crs/epsg/0/26703&..
.
```

6.3.3. Output format considerations (TBD)

OGC API - Features - Part 1: Core defines three conformance classes related to the output formats:

- GML
- GeoJSON
- HTML

GML has full CRS support and no further requirements are imposed by this standard.

GeoJSON normatively supports WGS84 (lon,lat) but the "prior arrangement" provision allows other coordinate systems to be used.

Requirement 16	/req/crs/geojson Servers that implement this extension and clients that use this extension shall be subject to the prior arragements provision of the GeoJSON standard (see https://tools.ietf.org/html/rfc7946#page-12).

NOTE	Need to do more work on HTML!

HTML only supports WGS84 based on schema.org dependency; not sure if this is an issue but schema.org annotations seem to require WGS84 (lat,lon) yet WFS core requires lon,lat by default.

6.3.4. Coordinate system and axis order

Because of the inconsistent provision of coordinate reference system metadata in geospatial encodings and the continued confusion caused by the axis order of coordinates, this standard defines a mechanism for a server to clearly and unambiguously assert the coordinate reference system and axis order being used in a response document independent of the requested output format.

Requirement 17	/req/crs/ogc-crs-header An HTTP header named `OGC-CRS` shall be used to assert the coordinate reference system and, optionally, the coordinate axis order used in a response document.

Requirement 18	/req/crs/ogc-crs-header-value The value of the `OGC-CRS` header shall be a URI referencing the coordinate reference system used in the response document with an optional parameter named `axisOrder`.

Requirement 19	/req/crs/ogc-crs-axis-order-value The value of the `axisOrder` parameter shall be an ordered list of axis names indicating the order in which coordinates are presented in a response document.

Requirement 20	/req/crs/ogc-crs-axis-names The axis names shall be taken from the coordinate reference system definition.

Requirement 21	/req/crs/ogc-crs-header-axis-action If the `axisOrder` parameter is not include with the `OGC-CRS` header, then the order of coordinates shall be assumed to be generated according to the requirements of the requested output format.

The following example illustrates the use of the `OGC-CRS` header.

Example 4. HTTP header declaring the CRS and axis order used in the body of the response

```
OGC-CRS: http://www.opengis.net/def/crs/OGC/1.3/CRS84; axisOrder=lon,lat
```

Annex A: Abstract Test Suite (Normative)

add test cases

Annex B: Revision History

Date	Release	Editor	Primary clauses modified	Description
2019-xx-xx	1.0.0-SNAPSHOT	J. Doe	all	initial version

Annex C: Bibliography

- Heazel, Ch.: **Guide to OGC API - Features**, https://example.org/fixme
- Open API Initiative: **OpenAPI Specification 3.0.2**, https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.2.md