

OGC API - Coverages - Part 1

Core

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OGC API - Coverages - Part 1: Core

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i. Abstract

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Chapter 1. Scope

This OGC API Coverages (https://github.com/opengeospatial/ogc_api_coverages) specification establishes how to access coverages as defined by the Coverage Implementation Schema (CIS) 1.1 (<http://docs.opengeospatial.org/is/09-146r6/09-146r6.html>) through a Web API such as those described by the OpenAPI specification (<https://www.openapis.org/>).

1.1. Service Scope

The functionality provided by API-Coverages resembles that of the [OGC Web Coverage Service \(WCS\) 2.1 Interface Standard](#). It is expected that Coverage APIs and WCS services will be able to interoperate, allowing developers to pick the solution best suited for their requirements.

The OGC is using an incremental approach to their API development. The initial goal is to develop a relatively simple API standard which will meet the needs of a large percentage of implementors. Additional capabilities will be added based on community demand.

As a result, this API-Coverages Part 1 - Core standard does not provide a full duplication of the WCS capabilities. The functionality covered in Part 1 is:

- Coverage extraction functionality
- Subsetting by domain set
- Subsetting of domain set
- Subsetting by range type (bands)
- Scaling
- Content type negotiation.

1.2. Content Scope

The API-Coverages standard provides access to content which complies with the Coverage Implementation Schema (CIS) 1.1 (<http://docs.opengeospatial.org/is/09-146r6/09-146r6.html>).

The functionality covered in Part 1 is:

- Gridded or multi-point coverages
- GeneralGridCoverage

Chapter 2. Conformance

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

The one Standardization Target for this standard is Web APIs.

OGC API-Common provides a common foundation for OGC API standards. Therefore, this standard should be viewed as an extension to API-Common. Conformance to this standard requires demonstrated conformance to the applicable Conformance Classes of API-Common.

This standard identifies five Conformance Classes. The Conformance Classes implemented by an API are advertised through the `/conformance` path on the landing page. Each Conformance Class has an associated Requirements Class. The Requirements Classes define the functional requirements which will be tested through the associated Conformance Class.

The Requirements Classes for OGC API-Coverages are:

- **Core**
- **Subset**
- **HTML**
- **JSON**
- **OpenAPI 3.0**

The *Core* Requirements Class is the minimal useful service interface for an OGC Coverages API. The requirements specified in this Requirements Class are mandatory for all implementations of API-Coverages.

The *Subset* Requirements Class provides capabilities to select a sub-set of a **Coverage** using a multi-dimensional "bounding box" which is suitable for any coordinate reference system and any dimension.

The *HTML* and *JSON* Requirements Classes address support for encodings commonly used with APIs.

The *OpenAPI 3.0* Requirements Class addresses the use of the OpenAPI 3.0 standard to document and communicate the API Definition.

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.

- Fielding, R., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., Berners-Lee, T.: IETF RFC 2616, **HTTP/1.1**, [RFC 2616](#)
- Rescorla, E.: IETF RFC 2818, **HTTP Over TLS**, [RFC 2818](#)
- Klyne, G., Newman, C.: IETF RFC 3339, **Date and Time on the Internet: Timestamps**, [RFC 3339](#)
- Berners-Lee, T., Fielding, R., Masinter, L.: IETF RFC 3986, **Uniform Resource Identifier (URI): Generic Syntax**, [RFC 3986](#)
- Duerst, M., Suignard, M.: IETF RFC 3987, **Internationalized Resource Identifiers (IRIs)**, [RFC 3987](#)
- Gregorio, J., Fielding, R., Hadley, M., Nottingham, M., Orchard, D.: IETF RFC 6570, **URI Template**, [RFC 6570](#)
- Nottingham, M.: IETF RFC 8288, **Web Linking**, [RFC 8288](#)
- OGC 19-072: **OGC API - Common - Part 1: Core**, (Draft) https://github.com/opengeospatial/oapi_common/blob/Master/19-072.pdf
- OGC 20-024: **OGC API - Common - Part 2: Geospatial Data**, (Draft) https://github.com/opengeospatial/oapi_common/blob/Master/20-024.pdf
- OGC 09-146: **OGC Coverage Implementation Schema (CIS)**, version 1.1, [CIS](#)
- OGC 19-008: **OGC GeoTIFF Standard**, Version 1.1, <http://docs.opengeospatial.org/is/19-008r4/19-008r4.html>
- OGC Schema: **OGC JSON Schema for Coverage Implementation Schema**, version 1.1, 2017, [CIS Schema](#)
- OGC 10-090: **OGC Network Common Data Form (NetCDF) Core Encoding Standard**, Version 1.0, http://portal.opengeospatial.org/files/?artifact_id=43732
- OGC 17-089: **OGC Web Coverage Service (WCS) Interface Standard - Core**, Version 2.1, ([WCS 2.1](#))
- Open API Initiative: **OpenAPI Specification 3.0.2**, [OpenAPI](#)
- **Schema.org**: [Schema.org](#)
- W3C: **HTML5**, W3C Recommendation, [HTML5](#)
- OGC: OGC 07-011, **Abstract Specification Topic 6: The Coverage Type and its Subtypes**, version 7.0 (identical to ISO 19123:2005), 2007
- OGC: OGC 08-094, **OGC® SWE Common Data Model Encoding Standard**, version 2, 2011
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- OGC: OGC 16-083, **Coverage Implementation Schema – ReferenceableGridCoverage Extension**, version 1, 2017
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- OGC: OGC 13-102r2, **Name type specification – Time and index coordinate reference system definitions** (OGC Policy Document), version 1, 2014
- IETF: RFC 7159, **The JavaScript Object Notation (JSON) Data Interchange Format**, <https://www.ietf.org/rfc/rfc7159.txt>, 2014
- W3C: W3C JSON-LD 1.0, **A JSON-based Serialization for Linked Data**. <http://www.w3.org/TR/json-ld/>, 2014
- W3C: W3C JSON-LD 1.0 **Processing Algorithms and API**. <http://www.w3.org/TR/json-ld-api>, 2014
- W3C: W3C RDF 1.1 **Concepts and Abstract Syntax**. <https://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/>, 2014

Chapter 4. Terms and Definitions

This document uses the terms defined in Sub-clause 5 of [OGC API - Common - Part 1: Core](#) (OGC 19-072), which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

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

4.1. Coverage

feature that acts as a function to return values from its range for any direct position within its spatiotemporal domain, as defined in OGC Abstract Topic 6

4.2. Regular grid

grid whose grid lines have a constant distance along each grid axis

4.3. Irregular grid

Grid whose grid lines have individual distances along each grid axis

4.4. Displaced grid

grid whose direct positions are topologically aligned to a grid, but whose geometric positions can vary arbitrarily

4.5. Mesh

coverage consisting of a collection of curves, surfaces, or solids, respectively

4.6. Partition [of a coverage]

separately stored coverage acting, by being referenced in the coverage on hand, as one of its components

4.7. Sensor model

mathematical model for estimating geolocations from recorded sensor data such as digital imagery

4.8. Transformation grid

grid whose direct positions are given by some transformation algorithm not further specified in this standard

Chapter 5. Conventions

The following conventions will be used in this document. Examples of conventions are symbols, abbreviations, use of XML schema, or special notes regarding how to read the document.

5.1. Identifiers

The normative provisions in this standard are denoted by the URI

<http://www.opengis.net/spec/ogcapi-coverages-1/1.0>

All requirements and conformance tests that appear in this document are denoted by partial URIs which are relative to this base.

5.2. Examples

Most of the examples provided in this standard are encoded in JSON. JSON was chosen because it is widely understood by implementers and easy to include in a text document. This convention should NOT be interpreted as a requirement that JSON must be used. Implementors are free to use any format they desire as long as there is a Conformance Class for that format and the API advertises its support for that Conformance Class.

5.3. Schema

JSON Schema is used throughout this standard to define the structure of resources. These schema are typically represented using YAML encoding. This convention is for the ease of the user. It does not prohibit the use of another schema language or encoding. Nor does it indicate that JSON schema is required. Implementations should use a schema language and encoding appropriate for the format of the resource.

5.4. UML Notation

Diagrams using the Unified Modeling Language (UML) adhere to the following conventions:

- UML elements having a package name of “GML” are those defined in the UML model of GML 3.2.1
- UML elements having a package name of “SWE Common” are those defined in the UML model of SWE Common 2.0
- UML elements not qualified with a package name, or with “CIS”, are those defined in this standard.

Further, in any class where an attribute name or association role name is identical to a name in some superclass the local definition overrides the superclass definition.

5.5. Namespace Prefix Conventions

UML diagrams and XML code fragments adhere to the namespace conventions shown in [Table 1](#). The namespace prefixes used in this document are not normative and are merely chosen for convenience. The namespaces to which the prefixes correspond are normative, however.

Whenever a data item from a CIS-external namespace is referenced this constitutes a normative dependency on the data structure imported together with all requirements defined in the namespace referenced.

Table 1. Namespace mapping conventions

| UML prefix | GML prefix | Namespace URL | Description |
|------------|------------|---|------------------------------------|
| CIS | cis | http://www.opengis.net/cis/1.1 | Coverage Implementation Schema 1.1 |
| CIS10 | cis10 | http://www.opengis.net/gmlcov/1.0 | Coverage Implementation Schema 1.0 |
| GML | gml | http://www.opengis.net/gml/3.2 | GML 3.2.1 |
| GML33 | gml33 | http://www.opengis.net/gml/3.3 | GML 3.3 |
| SWE Common | swe | http://www.opengis.net/swe/2.0 | SWE Common 2.0 |
| SML | sml | http://www.opengis.net/sensorml/2.0 | SensorML 2.0 |

Chapter 6. Overview

6.1. General

The OGC API family of standards enable access to resources using the HTTP protocol and its' associated operations (GET, PUT, POST, etc.). OGC API-Common defines a set of features which are applicable to all OGC APIs. Other OGC standards extend API-Common with features specific to a resource type. This OGC API-Coverages standard defines an API with two goals:

1. Provide access to **Coverages** conformant to the [OGC CIS standard](#).
2. Provide functionality comparable to that of the [OGC WCS standard](#).

Resources exposed through an OGC API may be accessed through a Universal Resource Identifier ([URI](#)). URIs are composed of three sections:

- Dataset distribution API: The endpoint corresponding to a dataset distribution, where the landing page resource as defined in OGC API - Common - Part 1: Core is available (subsequently referred to as Base URI or `{datasetAPI}`)
- Access Paths: Unique paths to Resources
- Query: Parameters to adjust the representation of a Resource or Resources like encoding format or subsetting

Access Paths are used to build resource identifiers. It is recommended, but not required, that these paths

Most resources are also accessible through links on previously accessed resources. Unique relation types are used for each resource.

[Table 2](#) summarizes the access paths and relation types defined in this standard.

Table 2. Coverage API Resources

| Resource URI | Relation Type | Description |
|--|---------------------------------|--|
| {datasetAPI}/ | <code>ogc:common:dataset</code> | Landing page for this dataset distribution |
| {datasetAPI}/api | <code>service-desc</code> | API description (e.g. OpenAPI) |
| {datasetAPI}/api | <code>service-doc</code> | API documentation (optional, e.g. HTML) |
| {datasetAPI}/conformance | <code>conformance</code> | Conformance Classes |
| {datasetAPI}/collections | <code>data</code> | The list off all collections available, some or all of which may be accessible using this Coverage API. Each of these collection objects take the same form as that of the collection resource object described immediately below. |

| Resource URI | Relation Type | Description |
|--|---|---|
| {datasetAPI}/collections/{coverageId} | ogc:common:collection | resource corresponding to the collection with the unique identifier {coverageId} , which may be accessible as a coverage. The resource will describe key elements such as an id , title , description , available crs and extent (the coverage envelope) as well as links to resources pertaining to this collection. For coverages, it will either embed or link to a CIS JSON encoding of both the range type and the domain set. It is comparable to a WCS DescribeCoverage response, with the exception that the range type and domain set may have to be retrieved separately by following a link to accommodate the case where they may be considerably large, and the domain set may support query parameters to subset it. |
| Coverages | | |
| {datasetAPI}/collections/{coverageId}/coverage | http://www.opengis.net/def/rel/ogc/1.0/coverage | returns the coverage including all of its components (domain set, range type, range set and metadata), to the extent that it is supported by the selected representation (see format encoding for ways to retrieve in specific formats). It is comparable to a WCS GetCoverage response. |
| {datasetAPI}/collections/{coverageId}/coverage/rangeset | http://www.opengis.net/def/rel/ogc/1.0/coverage-rangeset | if supported by the service and by the selected representation, returns only the coverage's range set, i.e., the actual values in the selected representation without any accompanying description or extra information. |
| {datasetAPI}/collections/{coverageId}/coverage/rangetype | http://www.opengis.net/def/rel/ogc/1.0/coverage-rangetype | if available separately from the collection resource, returns the coverage's range type information, i.e., a description of the data semantics (their components and data type). |
| {datasetAPI}/collections/{coverageId}/coverage/domainset | http://www.opengis.net/def/rel/ogc/1.0/coverage-domainset | if available separately from the collection resource, returns the coverage's domain set definition (the detailed n-dimensional space covered by the data). |
| {datasetAPI}/collections/{coverageId}/coverage/metadata | http://www.opengis.net/def/rel/ogc/1.0/coverage-metadata | if available, returns the associated coverage metadata as defined by the CIS model, which may be e.g. domain specific metadata. |

Where:

- {datasetAPI} = URI of the landing page for the API distributing the dataset
- {coverageId} = an identifier for a specific coverage (collection)

6.2. Coverage Implementation Schema

OGC API-Coverages specifies the fundamental API building blocks for interacting with coverages. The spatial data community uses the term 'coverage' for homogeneous collections of values located in space/time such as; spatio-temporal sensor, image, simulation, and statistical data.

This [OGC API - Coverages](#) standard establishes how to access coverages as defined by the [Coverage Implementation Schema \(CIS\) 1.1](#) through Web APIs. A high-level view of the CIS data model is provided in [Figure 1](#).



Figure 1. Abstract Coverage

If you are unfamiliar with the term 'coverage', the explanations on the [Coverages DWG Wiki](#)

provide more detail and links to educational material. Additionally, [Coverages: describing properties that vary with location \(and time\)](#) in the W3C/OGC Spatial Data on the Web Best Practice document may be considered.

6.3. API Behavior Model

The Coverages API is designed to be compatible but not conformant with the OGC Web Coverage Service. This allows API-Coverage and WCS implementations to co-exist in a single processing environment.

[OGC Web Coverage Service standard version 2](#) has an internal model of its storage organization based on which the classic operations GetCapabilities, DescribeCoverage, and GetCoverage can be explained naturally. This model consists of a single CoverageOffering resembling the complete WCS data store. It holds some service metadata describing service qualities (such as WCS extensions, encodings, CRSs, and interpolations supported, etc.). At its heart, this offering holds any number of OfferedCoverages. These contain the coverage payload to be served, but in addition can hold coverage-specific service-related metadata (such as the coverage's Native CRS).



Discussion has shown that the API model also assumes underlying service and object descriptions, so a convergence seems possible. In any case, it will be advantageous to have a similar "mental model" of the server store organization on hand to explain the various functionalities introduced below.

6.4. Dependencies

The OGC API-Coverages standard is an extension of the OGC API-Common standard. Therefore, an implementation of API-Coverages must first satisfy the appropriate Requirements Classes from API-Common. [Table 3](#) Identifies the API-Common Requirements Classes which are applicable to each section of this Standard. Instructions on when and how to apply these Requirements Classes are provided in each section.

Table 3. Mapping API-Coverages Sections to API-Common Requirements Classes

| API-Coverage Section | API-Common Requirements Class |
|--|---|
| API Landing Page | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/core |
| API Definition | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/core |
| Declaration of Conformance Classes | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/core |
| Collection Access | http://www.opengis.net/spec/ogcapi_common-2/1.0/req/collections |
| OpenAPI 3.0 | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/oas30 |
| JSON | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/json |
| HTML | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/html |

Chapter 7. Requirements Class "GeoData-Coverage"

7.1. Overview

| Requirements Class | |
|---|---|
| http://www.opengis.net/spec/ogcapi-coverages-1/1.0/req/geodata-coverage | |
| Target type | Web API |
| Dependency | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/core |
| Dependency | http://www.opengis.net/spec/ogcapi_common-2/1.0/req/collections |

The **GeoData-Coverage** Requirements Class defines the requirements for locating, understanding, and accessing a geospatial data resource as a coverage. The **GeoData-Coverage** Requirements Class is presented in five sections:

1. **API Platform**: a set of common capabilities
2. **Collection Access**: operations for accessing collections of **Coverages**
3. **Coverage Access**: operations for accessing **Coverage** resources
4. **Parameters**: parameters for use in the API-Coverage operations.
5. **General**: general principles for use with this standard.

7.2. Dependencies

The OGC API-Coverages standard is an extension of the OGC API - Common - Part 1: Core and Part 2: Geospatial Data Standards. Therefore, an implementation of API-Coverages must first satisfy the appropriate Requirements Classes from API-Common.

| Requirement 1 | /req/core/api-common |
|--|---|
| The API implementation SHALL demonstrate conformance with the following Requirements Classes of the OGC API-Common version 1.0 Standard. | |
| A | http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core |
| B | http://www.opengis.net/spec/ogcapi-common-2/1.0/req/collections |

7.3. Platform

API-Common defines a set of common capabilities which are applicable to any OGC Web API. Those capabilities provide the platform upon which resource-specific APIs can be built. This section describes those capabilities and any modifications needed to better support Coverage resources.

7.3.1. API landing page

The purpose of the landing page is to provide clients with a starting point for using the API. It provides the basic information needed to understand the purpose, structure, and capabilities of the API. The landing page also serves as the starting point for navigation. Any resource exposed through an API can be accessed using a path or link starting from the landing page.

The resources exposed by API-Common Core include:

- A description of the API,
- A declaration of conformance classes,
- A list of coverages available.

Those resources are sufficient for this standard.

Table 4. Dependencies

| |
|---|
| http://www.opengis.net/spec/ogcapi_common-1/1.0/req/core |
|---|

7.3.1.1. Operation

The **Landing Page** operation is defined in the **Core** conformance class of API-Common. No modifications are needed to support **Coverage** resources. The **Core** conformance class specifies only one way of performing this operation:

1. Issue a **GET** request on the **{datasetAPI}/** path

Support for **GET** on the **{datasetAPI}/** path is required by API-Common.

7.3.1.2. Response

A successful response to the **Landing Page** operation is defined in API-Common. The schema for this resource is provided in **Landing Page Response Schema**.

Landing Page Response Schema

```
type: object
required:
  - links
properties:
  title:
    description: The title of the API
    type: string
  description:
    description: A textual description of the API
    type: string
  links:
    description: Links to the resources exposed through this API.
    type: array
    items:
      $ref: link.yaml
```

The following JSON fragment is an example of a response to an OGC API-Coverages Landing Page operation.

```
{
  "title": "string",
  "description": "string",
  "links": [
    {
      "href": "http://data.example.org/",
      "rel": "self",
      "type": "application/json",
      "title": "this document"
    },
    {
      "href": "http://data.example.org/api",
      "rel": "service-desc",
      "type": "application/openapi+json;version=3.0",
      "title": "the API definition"
    },
    {
      "href": "http://data.example.org/conformance",
      "rel": "conformance",
      "type": "application/json",
      "title": "OGC conformance classes implemented by this API"
    },
    {
      "href": "http://data.example.org/collections",
      "title": "The list of available collections",
      "rel": "data"
    }
  ]
}
```

7.3.1.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.3.2. API definition

Every API is required to provide a definition document that describes the capabilities of that API. This definition document can be used by developers to understand the API, by software clients to connect to the server, or by development tools to support the implementation of servers and clients.

Table 5. Dependencies

http://www.opengis.net/spec/ogcapi_common-1/1.0/req/core

7.3.2.1. Operation

This operation is defined in the **Core** conformance class of API-Common. No modifications are

needed to support **Coverage** resources. The **Core** conformance class describes two ways of performing this operation:

1. Issue a **GET** request on the **{datasetAPI}/api** path
2. Follow the **service-desc** or **service-doc** link on the landing page

Only the link is required by API-Common.

7.3.2.2. Response

A successful response to the API Definition request is a resource which documents the design of the API. API-Common leaves the selection of format for the API Definition response to the API implementor. However, the options are limited to those which have been defined in the API-Common standard. At this time OpenAPI 3.0 is the only option provided.

7.3.2.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.3.3. Declaration of conformance classes

To support "generic" clients that want to access multiple OGC API standards and extensions - and not "just" a specific API / server, the API has to declare the conformance classes it claims to have implemented.

Table 6. Dependencies

http://www.opengis.net/spec/ogcapi_common-1/1.0/req/core

7.3.3.1. Operation

This operation is defined in the **Core** conformance class of API-Common. No modifications are needed to support **Coverage** resources. The **Core** conformance class describes two ways of performing this operation:

1. Issue a **GET** request on the **{datasetAPI}/conformance** path
2. Follow the **conformance** link on the landing page

Both techniques are required by API-Common.

7.3.3.2. Response

A successful response to the Conformance operation is a list of URLs. Each URL identifies an OGC Conformance Class for which this API claims conformance. The schema for this resource is defined in API-Common and provided for reference in [Conformance Response Schema](#).

| | |
|--|--|
| Requirement 2 | /req/geodata-coverage/conformance |
| The list of Conformance Classes advertised by the API SHALL include: | |

| | |
|---|---|
| A | http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/core |
| B | http://www.opengis.net/spec/ogcapi-common-2/1.0/conf/geodata |
| C | http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/geodata-coverage |

Conformance Response Schema

```

type: object
required:
  - conformsTo
properties:
  conformsTo:
    type: array
    items:
      type: string
      example: "http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/core"

```

The following JSON fragment is an example of a response to an OGC API-Coverages conformance operation.

Conformance Information Example

```

{
  "conformsTo": [
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/core",
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/json",
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/html",
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/oas3",
    "http://www.opengis.net/spec/ogcapi-common-2/1.0/conf/geodata",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/geodata-coverage",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/cisjson",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/cisrdf",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/netcdf",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/geotiff",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/html",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/geodata-subset",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/geodata-bbox",
    "http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/geodata-datetime"
  ]
}

```

7.3.3.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.4. Collection Access

API-Common starts with the assumption that spatial resources are organized into collections. An API will expose one or more collections. The API-Common Collections Conformance Class defines how to organize and provide access to a collection of collections.

API-Coverages observes that a coverage is a collection of measured values. Therefore, a coverage is a collection.

This standard extends the API-Common **Collections** conformance class to support collections of coverages, then extends that class to support **Coverage** unique capabilities.

7.4.1. Collections

The **Collections** operation returns a set of metadata which describes the collections available from this API. Each collection on a Coverages API will be a coverage. The coverages returned in the response can be limited using the **Bounding Box**, **Date-Time**, and **Limit** parameters.

Table 7. Dependencies

http://www.opengis.net/spec/ogcapi_common-1/1.0/req/collections

7.4.1.1. Operation

This operation is defined in the **Collections** conformance class of API-Common. No modifications are needed to support **Coverage** resources. The **Collections** conformance class describes two ways of performing this operation:

1. Issue a **GET** request on **{datasetAPI}/collections** path
2. Follow the **data** link on the landing page

Support for both the **{datasetAPI}/collections** path and the **data** link is required by API-Common.

7.4.1.2. Response

A successful response to the **Collections Operation** is a document which includes summary metadata for each collection accessible through the API. To keep the size of this response manageable, the summary metadata should be limited to just those elements which are essential for clients and those which are needed to support the filtering parameters.

| Recommendation 1 | /rec/geodata-coverage/coverageinfo |
|------------------|---|
| A | <p>The coverage metadata provided through the /collections resource SHOULD be limited to:</p> <ul style="list-style-type: none">• TBD• TBD• TBD |

```
type: object
required:
  - links
  - collections
properties:
  links:
    type: array
    items:
      $ref: link.yaml
  collections:
    type: array
    items:
      $ref: collectionInfo.yaml
```

The following JSON fragment is an example of a response to an OGC API-Coverages Collections operation.

Collections Example

```
{
  "TBD": [
    "filler1",
    "filler2"
  ]
}
```

7.4.1.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.4.2. Collection Information

Collection Information is the set of metadata which describes a single collection, or in the the case of API-Coverages, a single Coverage. An abbreviated copy of this information is returned for each Coverage in the `/collections` response.

Table 8. Dependencies

http://www.opengis.net/spec/ogcapi_common-1/1.0/req/collections

7.4.2.1. Operation

This operation is defined in the `Collections` conformance class of API-Common. No modifications are required to support `Coverage` resources. However, on a coverages API the the collections are also coverages. So in this standard the term `coverageid` is used instead of `collectionid`. The two terms are equivalent.

The **Collections** conformance class describes two ways of performing this operation:

1. Issue a **GET** request on the `{datasetAPI}/collections/{coverageid}` path
2. Follow the `ogc:common:collection` link on the ?????

NOTE | What is the origin of the "ogc:common:collection" link?

The `{coverageid}` parameter is the unique identifier for a single coverage on the API. The list of valid values for `{coverageid}` is provided in the `/collections` response.

Support for the `/collections/{coverageid}` path is recommended by API-Common. Support for the `ogc:common:collection` link is required.

7.4.2.2. Response

A successful response to the Collection Operation is a set of metadata which describes the collection identified by the `{coverageid}` parameter. This metadata is an extension to the set defined by API-Common. The additional elements are specific to Coverage resources.

```
type: object
required:
  - id
  - links
  - extent
  - domainSet
  - rangeType
properties:
  id:
    type: string
    example: address
  title:
    type: string
    example: address
  description:
    type: string
    example: An address.
  links:
    type: array
    items:
      $ref: link.yaml
    example:
      - href: http://data.example.com/buildings
        rel: item
      - href: http://example.com/concepts/buildings.html
        rel: describedBy
        type: text/html
  extent:
    $ref: extent.yaml
  itemType:
    description: indicator about the type of the items in the collection (the default
value is 'unknown').
    type: string
    default: unknown
  domainSet:
    $ref: coverage_domainset.json#/domainSet
  rangeType:
    $ref: coverage_rangetype.json#/rangeType
  crs:
    description: the list of coordinate reference systems supported by the API; the
first item is the default coordinate reference system
    type: array
    items:
      type: string
    default:
      - http://www.opengis.net/def/crs/OGC/1.3/CRS84
    example:
      - http://www.opengis.net/def/crs/OGC/1.3/CRS84
      - http://www.opengis.net/def/crs/EPSG/0/4326
```

The following JSON fragment is an example of a response to an OGC API-Coverages Collection Information operation.

Collection Information Resource Example

```
{
  "id": "CIS123456789",
  "title": "Bonn Germany",
  "description": "Image over the city of Bonn.",
  "extent": {
    "spatial": {
      "bbox" : [ [ 7.01, 50.63, 7.22, 50.78 ] ],
      "crs" : "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
    },
    "temporal": {
      "interval" : [ [ "2010-02-15T12:34:56Z", "2018-03-18T12:11:00Z" ] ]
    }
  },
  "CRS": [
    "http://www.opengis.net/def/crs/OGC/1.3/CRS84",
    "http://www.opengis.net/def/crs/EPSG/0/4326"
  ],
  "links": [
    {
      "rel": "http://www.opengis.net/def/rel/ogc/1.0/coverage",
      "type": "application/json",
      "title": "CIS Image",
      "href": "http://data.example.org/collections/CIS123456789/coverage"
    },
    {
      "rel" : "http://www.opengis.net/def/rel/ogc/1.0/coverage-domainset",
      "type" : "application/json",
      "href": "http://data.example.org/collections/CIS123456789/coverage/domainSet"
    },
    {
      "rel" : "http://www.opengis.net/def/rel/ogc/1.0/coverage-rangetype",
      "type" : "application/json",
      "href": "http://data.example.org/collections/CIS123456789/coverage/rangeType"
    }
  ]
}
```

7.4.2.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.5. Coverage Access

In this clause, API-Common is extended to support **Coverage** resources.

A **Coverage** is a collection of measured values. The structure of that collection is defined by the **CIS standard**. CIS contains four principle components:

- A **DomainSet** component describing the coverage's domain (the set of “direct positions”, i.e., the locations for which values are stored in the coverage)
- A **RangeType** component which describes the coverage's **RangeSet** data structure (in the case of images usually called the “pixel data type”).
- A **RangeSet** component containing the stored values (often referred to as “pixels”, “voxels”) of the coverage.
- A **Metadata** component which represents an extensible slot for metadata. The intended use is to hold any kind of application-specific metadata structures.

A coverage containing the **DomainSet**, **RangeType**, **RangeSet**, and **Metadata** components is accessible at

- The relative path **/coverage**
- The link relation **ogc:coverage:coverage**

The **DomainSet** and **RangeType** are accessible from resources linked by links within the **/collections/{coverageid}** resource, using the relation types <http://www.opengis.net/def/rel/ogc/1.0/coverage-domainset> and <http://www.opengis.net/def/rel/ogc/1.0/coverage-rangetype>, respectively. Those links may either point to separate resource, in which case the recommended paths are **/collections/{coverageid}/coverage/domainset** and **/collections/{coverageid}/coverage/rangetype**, or point to the coverage description resource itself the domain set and/or range type are embedded. In the latter case those links will point specifically to properties using #, e.g., **#domainset** and **#rangetype**.

The **RangeSet** may be available as its own resource as well, if supported by the selected representation (format).

If **Metadata** is available, it will also be available as its own resource.

The paths discussed in this section are all branches off of the **/collections/{coverageid}** root.

7.5.1. Coverage

The **Coverage** operation returns all the components of the coverage (rangeset, domain set, range type, metadata). It is comparable to a WCS GetCoverage operation.

7.5.1.1. Operation

The **Coverage** operation is defined by the following requirement.

| | |
|----------------------|--|
| Requirement 3 | /req/geodata-coverage/coverage-op |
|----------------------|--|

| | |
|---|---|
| A | <p>The API SHALL support the HTTP GET operation at the path <code>/collections/{coverageid}/coverage</code>.</p> <ul style="list-style-type: none"> <code>coverageid</code> is the local identifier for a <code>Coverage</code>. It serves the same role and is subject to the same requirements as the <code>collectionid</code> parameter defined in API-Common. |
|---|---|

7.5.1.2. Response

A successful response to the `Coverage` operation shall meet the following requirement.

| Requirement 4 | /req/geodata-coverage/coverage-success |
|---------------|--|
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code <code>200</code> . |
| B | The content of that response SHALL include the <code>rangeset</code> of the coverage equivalent to that defined in the JSON schema <code>coverage.json</code> . |
| C | The content of that response SHALL also include the <code>domainset</code> and <code>rangetype</code> as well, to the extent that the negotiated format can describe it. |
| D | The content of that response MAY also include the <code>metadata</code> for that coverage. The server SHOULD return that metadata if it is available and the negotiated format can describe it. |
| E | The response SHALL be encoded using the format(s) negotiated through the HTTP protocol. |
| F | If no format is negotiated, then the response SHALL be encoded using the format associated with the media type described in the link object which links to this resource, contained within the coverage (collection) resource. |

```
$schema: http://json-schema.org/draft-07/schema#
title: Coverage object
description: 'Component of OGC Coverage Implementation Schema 1.1. Last updated: 2016-
may-18.
  Copyright (c) 2016 Open Geospatial Consortium, Inc. All Rights Reserved. To obtain
  additional rights of use, visit http://www.opengeospatial.org/legal/.'
type: object
oneOf:
- required:
  - type
  - domainSet
  - rangeSet
  - rangeType
properties:
  id:
    type: string
  type:
    enum:
    - CoverageByDomainAndRangeType
  envelope:
    "$ref": coverage_envelope.json#/envelope
  domainSet:
    "$ref": coverage_domainset.json#/domainSet
  rangeSet:
    "$ref": coverage_rangeset.json#/rangeSet
  rangeType:
    "$ref": coverage_rangetype.json#/rangeType
  metadata:
    "$ref": coverage_metadata.json#/metadata
- required:
  - type
  - partitionSet
  - rangeType
properties:
  id:
    type: string
  type:
    enum:
    - CoverageByPartitioningType
  envelope:
    "$ref": coverage_envelope.json#/envelope
  partitionSet:
    "$ref": coverage_partitionset.json#/partitionSet
  rangeType:
    "$ref": coverage_rangetype.json#/rangeType
  metadata:
    "$ref": coverage_metadata.json#/metadata
```


The following JSON fragment is an example of a response to a Coverage request.

Coverage Example

```
{
  "TBD": [
    "filler1",
    "filler2"
  ]
}
```

7.5.1.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.6. Parameters

The API-Coverages standard inherits basic query and subsetting parameters from API-Common. This section provides a short description of each parameter and identifies the relevant requirements.

All of the permissions and recommendations in API-Common regarding these parameters also apply to API-Coverages implementations.

7.6.1. Coverage Domain Set

The **Coverage Domain Set** operation returns the coverage's domain set definition

7.6.1.1. Operation

The **Coverage Domain Set** operation is defined by the following requirement.

| Requirement 5 | /req/geodata-coverage/domainset-op |
|---------------|---|
| A | <p>The API SHALL include a link with the relation type http://www.opengis.net/def/rel/ogc/1.0/coverage-domainset within the links of the coverage (collection) resource, to a resource supporting the HTTP GET operation and returning a CIS JSON representation including a DomainSet property. This link can either be a link to a separate resource (e.g., recommended path /collections/{coverageid}/coverage/domainset) or a link to the coverage resource itself pointing to the property with # e.g., #DomainSet.</p> <ul style="list-style-type: none">coverageid is the local identifier for a Coverage. It serves the same role and is subject to the same requirements as the collectionid parameter defined in API-Common. |

7.6.1.2. Response

A successful response to the **Coverage Domain Set** operation shall meet the following requirement.

| Requirement 6 | /req/geodata-coverage/domainset-success |
|---------------|--|
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The content of that response SHALL provide the Domain Set definition of the coverage equivalent to that defined in the JSON schema coverage_domainset.json . |
| C | The response SHALL be encoded using the format(s) negotiated through the HTTP protocol. |
| D | If no format is negotiated, then the response SHALL be encoded using CIS JSON, which SHALL also be the format associated with the media type described in the link object which links to this resource, contained within the coverage (collection) resource. |

Coverage Domain Set Response Schema

```
$schema: http://json-schema.org/draft-07/schema#
domainSet:
  title: domainSet
  description: The domainSet describes the *direct positions* of the coverage, i.e.,
    the locations for which values are available.
  type: object
  oneOf:
    - required:
        - type
        - generalGrid
      properties:
        type:
          enum:
            - DomainSetType
        generalGrid:
          title: General Grid
          description: A general n-D grid is defined through a sequence of axes, each
            of which can be of a particular axis type.
          type: object
          required:
            - type
          additionalProperties: false
          properties:
            type:
              enum:
                - GeneralGridCoverageType
```

```

id:
  type: string
srsName:
  type: string
  format: uri
axisLabels:
  type: array
  items:
    type: string
axis:
  type: array
  items:
    type: object
    oneOf:
      - title: Index Axis
        description: An Index Axis is an axis with only integer positions
          allowed.
        required:
          - type
          - axisLabel
          - lowerBound
          - upperBound
        additionalProperties: false
        properties:
          type:
            enum:
              - IndexAxisType
          id:
            type: string
          axisLabel:
            type: string
          lowerBound:
            type: number
          upperBound:
            type: number
      - title: Regular Axis
        description: A Regular Axis is an axis where all direct coordinates
          are at a common distance from its immediate neighbors.
        required:
          - type
          - axisLabel
          - lowerBound
          - upperBound
          - resolution
          - uomLabel
        additionalProperties: false
        properties:
          type:
            enum:
              - RegularAxisType
          id:

```

```

      type: string
    axisLabel:
      type: string
    lowerBound:
      type:
        - number
        - string
        - 'null'
        - boolean
    upperBound:
      type:
        - number
        - string
        - 'null'
        - boolean
    uomLabel:
      type: string
    resolution:
      type: number
  - title: Irregular Axis
    description: An irregular axis enumerates all possible direct position
      coordinates.
    required:
      - type
      - axisLabel
      - uomLabel
      - coordinate
    additionalProperties: false
    properties:
      type:
        enum:
          - IrregularAxisType
      id:
        type: string
      axisLabel:
        type: string
      uomLabel:
        type: string
      coordinate:
        type: array
        items:
          type:
            - number
            - string
            - boolean
displacement:
  title: Displacement
  description: A Displacement is a warped axis nest where points on the
    grid all have their individual direct position coordinates. The
sequenceRule
  element describes linearization order.

```

```

type: object
oneOf:
- required:
  - type
  - axisLabels
  - uomLabels
  - coordinates
properties:
  type:
    enum:
      - DisplacementAxisNestType
  id:
    type: string
  axisLabel:
    type: string
  srsName:
    type: string
    format: uri
  axisLabels:
    type: array
    items:
      type: string
  uomLabels:
    type: array
    items:
      type: string
  coordinates:
    type: array
    items:
      type: array
      items:
        type:
          - number
          - string
          - boolean
- required:
  - type
  - axisLabels
  - uomLabels
  - coordinatesRef
properties:
  type:
    enum:
      - DisplacementAxisNestTypeRef
  id:
    type: string
  axisLabel:
    type: string
  srsName:
    type: string
    format: uri

```

```

        axisLabels:
          type: array
          items:
            type: string
        uomLabels:
          type: array
          items:
            type: string
        coordinatesRef:
          type: string
          format: uri
    model:
      title: Sensor model
      description: A Transformation By Sensor Model is a transformation
definition
      which is given by a SensorML 2.0 transformation specification.
      type: object
      required:
        - type
        - sensorModelRef
      properties:
        type:
          enum:
            - TransformationBySensorModelType
        id:
          type: string
        axisLabels:
          type: array
          items:
            type: string
        uomLabels:
          type: array
          items:
            type: string
        sensorModelRef:
          type: string
          format: uri
        sensorInstanceRef:
          type: string
          format: uri
    gridLimits:
      title: Grid limits
      description: This is the boundary of the array underlying the grid, given
        by its diagonal corner points in integer _60_3D. The grid limits can
        be omitted in case all axes are of type index axis, because then it
        repeats the grid information in a redundant way. The purpose of the
        axisLabels attribute, which lists the axis labels of all axisExtent
        elements in proper sequence, is to enforce axis sequence also in XML
        systems which do not preserve document order.
      type: object
      required:

```

```

- type
properties:
  indexAxis:
    title: Index Axis
    description: An Index Axis is an axis with only integer positions
      allowed.
    type: object
    required:
      - type
      - lowerBound
      - upperBound
    additionalProperties: false
    properties:
      type:
        enum:
          - IndexAxisType
      id:
        type: string
      axisLabel:
        type: string
      lowerBound:
        type: number
      upperBound:
        type: number
      srsName:
        type: string
        format: uri
      axisLabels:
        type: array
        items:
          type: string
- required:
  - type
  - directMultiPoint
properties:
  type:
    enum:
      - DomainSetType
  directMultiPoint:
    oneOf:
      - required:
          - type
          - coordinates
        properties:
          type:
            enum:
              - DirectMultiPointType
          coordinates:
            type: array
            items:
              type: array

```

```

        items:
          type:
            - number
            - string
            - boolean
        - required:
            - type
            - coordinatesRef
        properties:
          type:
            enum:
              - DirectMultiPointTypeRef
          coordinatesRef:
            type: string
            format: uri
        - required:
            - type
            - fileReference
        properties:
          type:
            enum:
              - DomainSetRefType
          id:
            type: string
            format: uri
          fileReference:
            type: string
            format: uri

```

The following JSON fragment is an example of a response to a Coverage DomainSet request.

Coverage DomainSet Example

```

{
  "TBD": [
    "filler1",
    "filler2"
  ]
}

```

7.6.1.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.6.2. Coverage Range Type

The **Coverage Range Type** operation returns the coverage's range type information (i.e., a description of the data semantics)

7.6.2.1. Operation

The **Coverage Range Type** operation is defined by the following requirement.

| Requirement 7 | /req/geodata-coverage/rangetype-op |
|---------------|---|
| A | <p>The API SHALL include a link with the relation type http://www.opengis.net/def/rel/ogc/1.0/coverage-rangetype within the links of the coverage (collection) resource, to a resource supporting the HTTP GET operation and returning a CIS JSON representation including a RangeType property. This link can either be a link to a separate resource (e.g., recommended path <code>/collections/{coverageid}/coverage/rangetype</code>) or a link to the coverage resource itself pointing to the property with <code>#</code> e.g., <code>#RangeType</code>.</p> <ul style="list-style-type: none">• coverageid is the local identifier for a Coverage. It serves the same role and is subject to the same requirements as the collectionid parameter defined in API-Common. |

7.6.2.2. Response

A successful response to the **Coverage Range Type** operation shall meet the following requirement.

| Requirement 8 | /req/geodata-coverage/rangetype-success |
|---------------|--|
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The content of that response SHALL describe the Range Type of the coverage equivalent to that defined in the JSON schema coverage_rangetype.json . |
| C | The response SHALL be encoded using the format(s) negotiated through the HTTP protocol. |
| D | If no format is negotiated, then the response SHALL be encoded using CIS JSON, which SHALL also be the format associated with the media type described in the link object which links to this resource, contained within the coverage (collection) resource. |

Coverage Range Type Response Schema

```
$schema: http://json-schema.org/draft-07/schema#
rangeType:
  title: rangeType
  description: The rangeType element describes the structure and semantics of a
```

```

coverage's
  range values, including (optionally) restrictions on the interpolation allowed
  on such values.
type: object
oneOf:
- required:
  - type
  - field
properties:
  type:
    enum:
      - DataRecordType
  field:
    type: array
    items:
      title: quantity
      description: quantity
      type: object
      required:
        - type
      properties:
        type:
          enum:
            - QuantityType
        id:
          type: string
          format: uri
        name:
          type: string
        definition:
          type: string
          format: uri
        uom:
          title: units of measure
          description: units of measure
          type: object
          required:
            - type
            - code
          properties:
            type:
              enum:
                - UnitReference
            id:
              type: string
              format: uri
            code:
              type: string
        constraint:
          title: Constraint
          description: Constraint

```

```

    type: object
    required:
    - type
    properties:
      type:
        enum:
        - AllowedValues
      id:
        type: string
        format: uri
      interval:
        type: array
        items:
          type:
            - number
            - string
            - boolean
    interpolationRestriction:
      title: interpolationRestriction
      description: Interpolation restriction
      type: object
      required:
      - type
      properties:
        type:
          enum:
          - InterpolationRestrictionType
      id:
        type: string
        format: uri
      allowedInterpolation:
        type: array
        items:
          type: string
          format: uri
- required:
- type
- fileReference
properties:
  type:
    enum:
    - RangeTypeRefType
  id:
    type: string
    format: uri
  fileReference:
    type: string
    format: uri

```

The following JSON fragment is an example of a response to a Coverage RangeType request.

```
{
  "TBD": [
    "filler1",
    "filler2"
  ]
}
```

7.6.2.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.6.3. Coverage Range Set

The **Coverage Range Set** operation returns the coverage's range set, i.e., the actual values in the coverage's Native Format (see [Media Types](#) for ways to retrieve inspecific formats)

7.6.3.1. Operation

The **Coverage Range Set** operation is defined by the following requirement.

| Requirement 9 | /req/geodata_coverage/rangeset-op |
|---------------|--|
| A | The API MAY support the HTTP GET operation at the path /collections/{coverageid}/coverage/rangeset . |
| B | The API SHOULD support it for selected formats which can describe the raw data values without any additional information. <ul style="list-style-type: none">• coverageid is the local identifier for a Coverage. It serves the same role and is subject to the same requirements as the collectionid parameter defined in API-Common. |

7.6.3.2. Response

A successful response to the **Coverage Range Set** operation shall meet the following requirement.

| Requirement 10 | /req/geodata_coverage/rangeset-success |
|----------------|--|
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |

| | |
|---|--|
| B | The content of that response SHALL contain the Range Set of the coverage equivalent to that defined in the JSON schema coverage_rangeset.json . |
| C | The response SHALL be encoded using the format(s) negotiated through the HTTP protocol. |
| D | If no format is negotiated, then the response SHALL be encoded using the format associated with the media type described in the link object which links to this resource, contained within the coverage (collection) resource. |

Coverage Range Set Response Schema

```

$schema: http://json-schema.org/draft-07/schema#
rangeSet:
  title: rangeSet
  description: 'The rangeSet lists a value for each of the coverage's direct
positions.
Values resemble the *payload* information of some particular direct positions.
Values can be composite (with a single nesting level, i.e.: composites always
consist of atomics), or atomic (emulated through single-component composites)
whereby the sequence, structure, and meaning of every value is defined through
the rangeType. Values can be represented in-line or by reference to an external
file which may have any suitable encoding.'
```

```

  type: object
  oneOf:
    - required:
      - type
      - dataBlock
    properties:
      type:
        enum:
          - RangeSetType
      dataBlock:
        title: dataBlock
        description: Data block objects
        type: object
        required:
          - type
          - values
        properties:
          type:
            enum:
              - VDataBlockType
              - CDataBlockType
          values:
            type: array
            items:
```

```

      type:
      - number
      - string
      - 'null'
      - boolean
    - required:
      - type
      - fileReference
    properties:
      type:
        enum:
          - RangeSetRefType
      fileReference:
        type: array
        items:
          type: string
          format: uri

```

The following JSON fragment is an example of a response to a Coverage RangeSet request.

Coverage RangeSet Example

```

{
  "TBD": [
    "filler1",
    "filler2"
  ]
}

```

7.6.3.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

7.6.4. Coverage Metadata

The **Coverage Metadata** operation returns the coverage's metadata (may be empty)

7.6.4.1. Operation

The **Coverage Metadata** operation is defined by the following requirement.

| Requirement 11 | /req/geodata-coverage/metadata-op |
|----------------|---|
| A | The API MAY support the HTTP GET operation at the path /collections/{coverageid}/coverage/metadata . |

| | |
|---|--|
| B | <p>The API SHOULD support it, if available, for selected formats which can describe it.</p> <ul style="list-style-type: none"> • <code>coverageid</code> is the local identifier for a <code>Coverage</code>. It serves the same role and is subject to the same requirements as the <code>collectionid</code> parameter defined in API-Common. |
|---|--|

7.6.4.2. Response

A successful response to the `Coverage Metadata` operation shall meet the following requirement.

| Requirement 12 | /req/geodata-coverage/metadata-success |
|----------------|--|
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code <code>200</code> . |
| B | The content of that response SHALL contain metadata which describes the coverage equivalent to that defined in the JSON schema <code>coverage_metadata.json</code> . |
| C | The response SHALL be encoded using the format(s) negotiated through the HTTP protocol. |
| D | If no format is negotiated, then the response SHALL be encoded using the format associated with the media type described in the link object which links to this resource, contained within the coverage (collection) resource. |

Coverage Metadata Response Schema

```
$schema: http://json-schema.org/draft-07/schema#
metadata:
  description: The metadata element is a container of any (not further specified)
    information which should be transported along with the coverage on hand, such
    as domain-specific metadata.
  type: object
  properties: {}
```

The following JSON fragment is an example of a response to a Coverage Metadata request.

```
{
  "TBD": [
    "filler1",
    "filler2"
  ]
}
```

7.6.4.3. Error situations

The requirements for handling unsuccessful requests are provided in [HTTP Response](#). General guidance on HTTP status codes and how they should be handled is provided in [HTTP status codes](#).

TODO: Move `geodata-filteredList` conformance class into its own clause, which may end up only in OGC API - Common - Part 2: Geospatial data has Coverage doesn't add anything.

TODO: Create new clauses for conformance classes for `coverage-bbox` and `coverage-dateTime` (or potentially make this a single one), which are additional ways to sub-select the actual coverage data being returned that a service may opt to support.

TODO: Limit and Paged response may apply to both listing collections (`geodata-filteredList`) and the coverage itself. Is it a requirement to support Limit for either of these? Is it separate conformance classes? It would be difficult for static servers, and paging makes less sense for coverages than it does for many small features.

7.6.5. Parameter bbox

The Bounding Box (bbox) parameter is defined in API-Common. The following requirement governs use of that parameter in a Coverage API.

| Requirement 13 | <code>/req/geodata-filteredList/bbox-parameter</code> |
|----------------|--|
| A | An API implementing Common - Part 2: Geospatial data MAY support the Bounding Box (bbox) parameter for <code>/collections</code> requests. |
| B | Requests which include the Bounding Box parameter SHALL comply with API-Common requirement <code>/req/core/rc-bbox-definition</code> . |
| C | Responses SHALL be appropriately filtered, returning only collections whose spatial extent intersects with the specified bounding box parameter. |

7.6.6. Parameter datetime

The Date-Time (datetime) parameter is defined in API-Common. The following requirement governs use of that parameter in a Coverage API.

| Requirement 14 | /req/geodata-filteredList/datetime-parameter |
|----------------|--|
| A | An API implementing Common - Part 2: Geospatial data MAY support the Date-Time (datetime) parameter for /collections requests. |
| B | Requests which include the Date-Time parameter SHALL comply with API-Common requirement /req/geodata-filteredList/rc-time-definition . |
| C | Responses SHALL be appropriately filtered, returning only collections whose temporal extent intersects with the specified date time parameter. |

7.6.7. Parameter Limit

The Limit (limit) parameter is defined in API-Common. The following requirement governs use of that parameter in a Coverage API.

| Requirement 15 | /req/geodata-filteredList/limit-parameter |
|----------------|--|
| A | A Coverage API SHALL support the Limit (limit) parameter for /collections requests. |
| B | Requests which include the Limit parameter SHALL comply with API-Common requirement /req/core/rc-limit-definition . |
| C | Responses to Limit requests SHALL comply with API-Common requirements: <ul style="list-style-type: none">• /req/core/rc-limit-response• /req/core/rc-numberReturned• /req/core/rc-numberMatched |

7.6.8. Combinations of Filter Parameters

Any combination of **bbox**, **datetime** and parameters for filtering on coverage properties is allowed. Note that the requirements on these parameters imply that only coverages matching all the predicates are in the result set; i.e., the logical operator between the predicates is 'AND.'

7.6.9. Paged Response

One consequence of the Limit parameter is that the full result set is not delivered to the user. However, users frequently want to know how big the result set it and how to access the rest of it. The following requirement add information to the response to address that need.

| Requirement 16 | /req/geodata-coverage/paged-response |
|----------------|--|
| A | <p>Responses to a filtered operation that only return a portion of the full selected resource set SHALL comply with API-Common requirements:</p> <p>TODO: These Features resources pertained to individual feaures being returned, and are not currently defined in Common. Their paging mechanism likely does not apply well to coverages as well.</p> <ul style="list-style-type: none">• /req/core/rc-response• /req/core/fc-links• /req/core/fc-rel-type• /req/core/fc-timestamp• /req/core/fc-numberMatched• /req/core/fc-numberReturned |

7.7. General

7.7.1. HTTP Response

Each HTTP request shall result in a response that meets the following requirement.

| Requirement 17 | /req/core/http-response |
|----------------|--|
| A | An HTTP operation SHALL return a response which includes a status code and an optional description elements. |
| B | If the status code is not equal to 200, then the description element SHALL be populated. |

The YAML schema for these results is provided in [HTTP Response Schema](#).

```

type: object
required:
  - code
properties:
  code:
    type: string
  description:
    type: string

```

7.7.2. HTTP status codes

The **Status Codes** listed in [Table 4](#) are of particular relevance to implementors of this standard. Status codes 200, 400, and 404 are called out in API requirements. Therefore, support for these status codes is mandatory for all compliant implementations. The remainder of the status codes in [Table 4](#) are not mandatory, but are important for the implementation of a well functioning API. Support for these status codes is strongly encouraged for both client and server implementations.

Table 9. Typical HTTP status codes

| Status code | Description |
|-------------|---|
| 200 | A successful request. |
| 304 | An entity tag was provided in the request and the resource has not been changed since the previous request. |
| 400 | The server cannot or will not process the request due to an apparent client error. For example, a query parameter had an incorrect value. |
| 401 | The request requires user authentication. The response includes a WWW-Authenticate header field containing a challenge applicable to the requested resource. |
| 403 | The server understood the request, but is refusing to fulfill it. While status code 401 indicates missing or bad authentication, status code 403 indicates that authentication is not the issue, but the client is not authorised to perform the requested operation on the resource. |
| 404 | The requested resource does not exist on the server. For example, a path parameter had an incorrect value. |
| 405 | The request method is not supported. For example, a POST request was submitted, but the resource only supports GET requests. |
| 406 | The Accept header submitted in the request did not support any of the media types supported by the server for the requested resource. |
| 500 | An internal error occurred in the server. |

More specific guidance is provided for each resource, where applicable.

The API Description Document describes the HTTP status codes generated by that API. This should not be an exhaustive list of all possible status codes. It is not reasonable to expect an API designer to

control the use of HTTP status codes which are not generated by their software. Therefore, it is recommended that the API Description Document limit itself to describing HTTP status codes relevant to the proper operation of the API application logic. Client implementations should be prepared to receive HTTP status codes in addition to those described in the API Description Document.

| Permission 1 | /per/geospatial-data/additional-status-codes |
|--------------|---|
| A | Servers MAY support other capabilities of the HTTP protocol and, therefore, MAY return other status codes than those listed in Table 4 , too. |

Chapter 8. Media Types

This standard does not mandate any particular encoding or format. However, it does provide extensions for encodings which are commonly used in OGC APIs. These extensions include:

- [CIS JSON](#)
- [HTML](#)

Neither of these encodings are mandatory. An implementor of this standard may choose to implement neither of them, selecting different encodings instead.

In addition to the Requirements Classes, there are additional coverage formats which implementors should be aware of. These formats apply to encodings of pixel data. Since this data is typically binary, it is largely opaque to the API.

8.1. HTML Encoding

Support for HTML is recommended. HTML is the core language of the World Wide Web. An API that supports HTML will support browsing the spatial resources with a web browser and will also enable search engines to crawl and index those resources.

8.2. CIS JSON Encoding

Support for CIS JSON is recommended. JSON is a commonly used format that is simple to understand and well supported by tools and software libraries.

JSON structures documented in this standard are defined using JSON Schema. These schema are available in JSON and YAML formats from <http://schemas.opengis.net/tbd>

When coverage resources (the coverage as a whole, range set, domain set, range type, meta data) advertise the `application/json` media type, it refers to the CIS JSON encoding.

This API-Coverages standard is built around the [OGC Coverage Implementation Schema \(CIS\)](#). CIS content often includes multi-dimensional coordinates and coordinate reference systems in sensor and analytic space. These "Engineering" coordinate reference systems cannot be represented using WGS-84.

The [OGC JSON Schema for CIS](#) standard addresses that need by defining a JSON schema for the CIS standard. This format should be used when the `application/json` media type is specified to encode all of the `{datasetAPI}/collections/{coverageid}/coverage*` resources. A CIS JSON representation of the range type and domain set for the coverage is also required to be either embedded in properties or linked from the `/collections/{collectionId}` resource.

Other encodings such as CoverageJSON must use an alternate media type.

8.3. Binary

A coverage can also be distributed in binary form, for which a number of formats are commonly used:

- CIS RDF
- NetCDF
- GeoTIFF
- PNG
- JPEG
- JPEG-2000

OGC CIS also defines multipart encoding of the different components of a coverage. This allows the result to have a "canonical" header while components can be factored out and represented in some (more efficient) binary format. Any suitable container format (such as zip, multipart/mime, SAFE, etc.) can "bundle" these components into one coverage file ready for shipping.

With OGC API - Coverages, given that the description of the coverage is easily available at the /collections/{collectionId} resource, with the range type and domain set either embedded or linked from that resource, an implementation may prefer to keep single-part binary formats encoding all components to the best it can, as they might be more directly interoperable.

8.4. Media Types

A description of the media types is mandatory for any OGC standard which involves data encodings. The list of suitable media types for the API-Coverages standard is provided in [Table 5](#).

Coverages can be encoded in any suitable data format, including formats as GML, CIS JSON, GeoTIFF, and NetCDF. Further, coverages can be represented by a single document (stream or file) or by a hierarchically organized set of documents, each of which can be encoded individually – for example, the domain set, range type, and metadata may be encoded in easily parseable GML, CIS JSON, or RDF while the range set is encoded in some compact binary format like NetCDF or JPEG2000. Such partitioning allows for coverages tiled in space, time, or mixed, thereby enabling mosaics, time-interleaved coverages, and efficiently subtable datacubes.

Table 10. API-Coverages media Types

| Encoding | media type |
|-----------------|---------------------------------|
| HTML | text/html |
| JSON / CIS JSON | application/json |
| CIS RDF | TODO: |
| CoverageJSON | TODO: |
| GeoTIFF | image/tiff; application=geotiff |
| PNG | image/png |

| | |
|-----------|----------------------|
| JPEG | image/jpeg |
| JPEG-2000 | image/jp2 |
| NetCDF | application/x-netcdf |

NOTE Consider adding a table showing valid media types for each CIS component.

8.5. Default Encodings

The media type used to encode a response to a request shall be determined through the HTTP content negotiation protocol as specified in API-Common. If not using content negotiation, the encoding must follow the media type described in the link to the resource from the collection.

Unresolved directive in OAPI_Coverages.adoc -
include::clause_9_coverage_subset_and_scaling.adoc[]

Chapter 9. Requirements Class HTML

The following requirements apply to an OGC API-Coverage implementation when the following conditions apply:

1. The API advertises conformance to the HTML Conformance Class
2. The client negotiates an HTML format

The HTML Requirements Class restricts requirements defined in the **GeoData-Coverage** Requirements Class by imposing encoding-specific requirements. At this time, these additional requirements only apply to the HTTP response payloads. The sections below identify the scope of each new requirement and the **GeoData-Coverage** requirements which lay within each scope.

| Requirements Class | |
|---|--|
| http://www.opengis.net/spec/ogcapi-coverages-1/1.0/req/html | |
| Target type | Web API |
| Dependency | Conformance Class "Core" |
| Dependency | API-Common HTML |
| Dependency | HTML5 |
| Dependency | Schema.org |

9.1. Common

This section covers the requirements inherited from the API-Common standard. Its scope includes responses for the following operations:

- **{datasetAPI}/**: Dataset API Landing Page
- **{datasetAPI}/api**: API Description
- **{datasetAPI}/conformance**: Conformance Classes
- **{datasetAPI}/collections**: Collections
- **{datasetAPI}/collections/{coverageid}**: Collection Information

| | |
|---|---|
| Requirement 18 | /req/html/api-common |
| Extends | /req/core/api-common |
| The API SHALL demonstrate conformance with the following Requirements Class of the OGC API-Common version 1.0 Standard. | |
| A | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/html |

It is also necessary to advertise conformance with this Requirements Class.

| | |
|--|---|
| Requirement 19 | /req/html/conformance |
| The list of Conformance Classes advertised by the API SHALL include: | |
| A | http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/html |

9.2. Coverage

This section covers the [Coverage](#) response for the `{datasetAPI}/collections/{coverageid}/coverage` operation.

| | |
|-----------------------|--|
| Requirement 20 | /req/html/coverage-success |
| Restricts | /req/core/coverage-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a valid HTML document |
| C | The response SHALL include content equivalent to that defined in JSON schema coverage.json . |

9.3. Coverage Domain Set

This section covers the [Coverage Domain Set](#) response for the `{datasetAPI}/collections/{coverageid}/coverage/domainset` operation.

| | |
|-----------------------|--|
| Requirement 21 | /req/html/domainset-success |
| Restricts | /req/core/domainset-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a valid HTML document |
| C | The response SHALL include content equivalent to that defined in JSON schema coverage_domainset.json . |

9.4. Coverage Range Type

This section covers the [Coverage Range Type](#) response for the

`{datasetAPI}/collections/{coverageid}/coverage/rangetype` operation.

| | |
|-----------------------|--|
| Requirement 22 | /req/html/rangetype-success |
| Restricts | /req/core/rangetype-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a valid HTML document |
| C | The response SHALL include content equivalent to that defined in JSON schema coverage_rangetype.json . |

9.5. Coverage Range Set

This section covers the [Coverage Range Set](#) response for the `{datasetAPI}/collections/{coverageid}/coverage/rangeset` operation.

| | |
|-----------------------|---|
| Requirement 23 | /req/html/rangeset-success |
| Restricts | /req/core/rangeset-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a valid HTML document |
| C | The response SHALL include content equivalent to that defined in JSON schema coverage_rangeset.json . |

9.6. Coverage Metadata

This section covers the [Coverage Metadata](#) response for the `{datasetAPI}/collections/{coverageid}/coverage/metadata` operation.

| | |
|-----------------------|--|
| Requirement 24 | /req/html/metadata-success |
| Restricts | /req/core/metadata-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |

| | |
|---|---|
| B | The response SHALL be a valid HTML document |
| C | The response SHALL include content equivalent to that defined in JSON schema coverage_metadata.json . |

Chapter 10. Requirements Class CIS JSON

The following requirements apply to an OGC API-Coverage implementation when the following conditions apply:

1. The API advertises conformance to the CIS JSON Conformance Class
2. The client negotiates a JSON or CIS JSON format

The CIS JSON Requirements Class restricts requirements defined in the **GeoData-Coverage** Requirements Class by imposing encoding-specific requirements. At this time, these additional requirements only apply to the HTTP response payloads. The sections below identify the scope of each new requirement and the **GeoData-Coverage** requirements which lay within each scope.

| Requirements Class | |
|---|---|
| http://www.opengis.net/spec/ogcapi_coverages-1/1.0/req/cisjson | |
| Target type | Web API |
| Dependency | Requirements Class "API-Common Core" |
| Dependency | API-Common JSON |
| Pre-conditions | 1) The API advertises conformance to the CIS JSON Conformance Class 2) The client negotiates use of the JSON or CIS JSON encoding. |

10.1. Common

This section covers the requirements inherited from the API-Common standard. Its scope includes responses for the following operations:

- **{datasetAPI}/**: Dataset API Landing Page
- **{datasetAPI}/api**: API Description
- **{datasetAPI}/conformance**: Conformance Classes
- **{datasetAPI}/collections**: Collections
- **{datasetAPI}/collections/{coverageid}**: Collection Information

| | |
|---|---|
| Requirement 25 | /req/cisjson/api-common |
| Extends | /req/core/api-common |
| The API SHALL demonstrate conformance with the following Requirements Class of the OGC API-Common version 1.0 Standard. | |
| A | http://www.opengis.net/spec/ogcapi_common-1/1.0/req/json |

It is also necessary to advertise conformance with this Requirements Class.

| | |
|--|---|
| Requirement 26 | /req/cisjson/conformance |
| The list of Conformance Classes advertised by the API SHALL include: | |
| A | http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/cisjson |

10.2. Coverage

This section covers the [Coverage](#) response for the `{datasetAPI}/collections/{coverageid}/coverage` operation.

| | |
|-----------------------|---|
| Requirement 27 | /req/cisjson/coverage-success |
| Restricts | /req/core/coverage-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a CIS JSON document which validates against the JSON schema coverage.json . |

10.3. Coverage Domain Set

This section covers the [Coverage Domain Set](#) response for the `{datasetAPI}/collections/{coverageid}/coverage/domainset` operation.

| | |
|-----------------------|---|
| Requirement 28 | /req/cisjson/domainset-success |
| Restricts | /req/core/domainset-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a CIS JSON document which validates against the JSON schema coverage_domainset.json . |

10.4. Coverage Range Type

This section covers the [Coverage Range Type](#) response for the `{datasetAPI}/collections/{coverageid}/coverage/rangetype` operation.

| | |
|-----------------------|---------------------------------------|
| Requirement 29 | /req/cisjson/rangetype-success |
|-----------------------|---------------------------------------|

| | |
|------------------|---|
| Restricts | /req/core/rangetype-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a CIS JSON document which validates against the JSON schema coverage_rangetype.json . |

10.5. Coverage Range Set

This section covers the [Coverage Range Set](#) response for the [{datasetAPI}/collections/{coverageid}/coverage/rangeset](#) operation.

| | |
|-----------------------|--|
| Requirement 30 | /req/cisjson/rangeset-success |
| Restricts | /req/core/rangeset-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a CIS JSON document which validates against the JSON schema coverage_rangeset.json . |

10.6. Coverage Metadata

This section covers the [Coverage Metadata](#) response for the [{datasetAPI}/collections/{coverageid}/coverage/metadata](#) operation.

| | |
|-----------------------|--|
| Requirement 31 | /req/cisjson/metadata-success |
| Restricts | /req/core/metadata-success |
| A | A successful execution of the operation SHALL be reported as a response with a HTTP status code 200 . |
| B | The response SHALL be a JSON document which validates against the JSON schema coverage_metadata.json . |

Chapter 11. Requirements class "OpenAPI 3.0"

| Requirements Class | |
|---|---|
| http://www.opengis.net/spec/ogcapi-coverages/1.0/req/oas30 | |
| Target type | Web API |
| Dependency | Conformance Class "Core" |
| Dependency | OGC API-Common Standard 1.0 |
| Dependency | OpenAPI Specification 3.0.2 |

The OpenAPI 3.0 Requirements Class is applicable to API-Coverages as well. So an implementation of API-Coverages which supports OpenAPI 3.0 as an API Description format must also comply with the API-Common oas30 Conformance Class.

| | |
|-----------------------|--|
| Requirement 32 | /req/oas30/oas-common |
| Extends | /req/core/api-common |
| A | The API SHALL demonstrate conformance with the following Requirements Class of the OGC API-Common version 1.0 Standard. http://www.opengis.net/spec/ogcapi-common-1/1.0/req/oas30 . |

Implementations must also advertise conformance with this Requirements Class.

| | |
|--|---|
| Requirement 33 | /req/oas30/conformance |
| The list of Conformance Classes advertised by the API SHALL include: | |
| A | http://www.opengis.net/spec/ogcapi-coverages-1/1.0/conf/oas30 |

Annex A: Conformance Class Abstract Test Suite (Normative)

NOTE

Ensure that there is a conformance class for each requirements class and a test for each requirement (identified by requirement name and number)

A.1. Conformance Class A

A.1.1. Requirement 1

| | |
|----------------------|-------------------------------|
| Test id: | /conf/conf-class-a/req-name-1 |
| Requirement: | /req/req-class-a/req-name-1 |
| Test purpose: | Verify that... |
| Test method: | Inspect... |

A.1.2. Requirement 2

Annex B: Revision History

| Date | Release | Editor | Primary clauses modified | Description |
|------------|----------|-----------|--------------------------|------------------|
| 2019-03-06 | Template | C. Heazel | all | initial template |

Annex C: Glossary

- **Conformance Test Module**

set of related tests, all within a single conformance test class (OGC 08-131r3)

| | |
|--------------|---|
| NOTE: | When no ambiguity is possible, the word test may be omitted. i.e. conformance test module is the same as conformance module . Conformance modules may be nested in a hierarchical way. This term and those associated to it are included here for consistency with ISO 19105. |
|--------------|---|

- **Conformance Test Class; Conformance Test Level**

set of **conformance test modules** that must be applied to receive a single **certificate of conformance**. (OGC 08-131r3)

| | |
|--------------|--|
| NOTE: | When no ambiguity is possible, the word test may be left out, so conformance test class may be called a conformance class . |
|--------------|--|

- **Executable Test Suite (ETS)**

A set of code (e.g. Java and CTL) that provides runtime tests for the assertions defined by the ATS. Test data required to do the tests are part of the ETS (OGC 08-134)

- **Recommendation**

expression in the content of a document conveying that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited (OGC 08-131r3)

| | |
|--------------|---|
| NOTE: | "Although using normative language, a recommendation is not a requirement . The usual form replaces the shall (imperative or command) of a requirement with a should (suggestive or conditional)." (ISO Directives Part 2) |
|--------------|---|

- **Requirement**

expression in the content of a document conveying criteria to be fulfilled if compliance with the document is to be claimed and from which no deviation is permitted (OGC 08-131r3)

- **Requirements Class**

aggregate of all requirement modules that must all be satisfied to satisfy a conformance test class (OGC 08-131r3)

- **Requirements Module**

aggregate of **requirements** and **recommendations** of a specification against a single **standardization target** type (OGC 08-131r3)

- **Standardization Target**

entity to which some requirements of a standard apply (OGC 08-131r3)

| | |
|--------------|---|
| NOTE: | The standardization target is the entity which may receive a certificate of conformance for a requirements class. |
|--------------|---|

Annex D: Bibliography

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