OGC Testbed-15: Images and ChangesSet API Engineering Report
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OGC Public Engineering Report

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i. Abstract

The OGC API – Images and Changeset draft specification addresses the use case of an OGC API tile server that serves image tiles and a client that portrays the result as a set of images. The tile server uses a set of images (e.g. a set of remote sensing satellite scenes or a set of drone pictures) in the backend and they are also accessible by an API - Images. The source images can be updated and therefore the tile server also needs to be able to deliver only the tiles that have changed. The draft specification is divided into two independent parts that can be used in broader scenarios:

- The OGC API – Images: Enables managing (retrieving, creating and updating) sets of images that are georeferenced. The images does not follow any tile scheme, and can partially or totally overlap. The API enables a mosaicking use case (where the imagery is combined in a single bigger “picture”) but could also serve a use case in which a moving camera is taking pictures at locations along a route and then stores the images as a single collection.

- The Changeset filter: Enables filtering a request to a data service in a way that only recent changes are delivered. It can be applied to OGC API that provide access to data and in particular to the OGC API tiles.

The OGC API – Images simplifies the creation and maintenance of sets of images that can then be exposed and retrieved by other OGC API’s, such as OGC API – Coverages. The use of the Changeset filter helps keep clients synchronized with changes to the source content on servers while also minimizing the bandwidth necessary for the synchronization.

This draft specification covers the following conformance classes:

- The image core describes how to retrieve images from an image set.
- The image transaction describes how to create or update an image in an existing image set.
- The changeset core describes how to filter data requests using a checkpoint and how the changeset is encoded
- The changeset tiles details the changeset encoding in the case of a multi-tiles request.

The OWS Common SWG is expected to discuss and achieve consensus on the changeset requirements classes and integrate them into a building block that every data OGC API could use. The Web Coverage Service (WCS) SWG is expected to consider the OGC API – Images requirements classes to provide an easy solution for creating and updating sets of images that are the backend content for a coverage server.

i.i Executive Summary

This draft specification is addressing the case of a tile server that serves tiles that portrays the result of mosaicking a set of images. This images can be updated from time to time and the tile server needs to be able to deliver only the tiles that has changed. The draft specification can be divided into two independent parts that can be used in broader scenarios:

- The OGC API images: it allows managing (retrieving, creating and updating) sets of images that are georeferenced. It serves the mosaicking use case but it could also serve a use case where a moving camera is taking pictures at some points in a route and stores the images as a single collection.
• The ChangeSet filter: it allows filtering a request to a data service in a way that only recent changes are delivered.

The OGC API images simplifies the creation and maintenance of sets of images that can then be exposed and retrieved by other OGC API’s such as OGC API coverages, OGC API coverates etc. The use of ChangeSet filter helps on keeping clients synchronized with changes in servers, minimizing the bandwidth necessary for the synchronization.

This draft specification covers the following conformance classes:

• The image core describes how to retrieve images from an image set.
• The image transaction describes how create or update an image in an existing image set.
• The tiles info proposes a mechanism to provide extra information about one point in a tile. It requires further elaboration.
• The changeset core describes how to filter data requests using a checkpoint and how the changeset is encoded
• The changeset tiles describes the particularities of the changeset encoding in the case of request to multi-tiles.

The OWS Common.SWG is expected to take case of the changeset requirements classes and integrate them into a building bloc that every data OGC API could use.

The WCS.SWG is expected to consider the OGC API - images requirements classes to provide an easy solution for creating an updating sets of images that aliment a coverage server.

ii. Keywords

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

ogcdoc, OGC document, tiling, WMTS, image, API, updates, synchronization

iii. Preface

The content of this OGC Engineering Report (ER) focuses on the use case in which a service provides access to a set of images that are part of a spatiotemporal series, such as a remote sensing product distributed as granules. These images are regularly updated with new imagery such as from an active remote sensing platform that produces updated images of the Earth. To fulfill requirements for the above use case, an image service uses the draft OGC API - Tiles specification, which is an evolution of the OGC Web Map Tile Service (WMTS), to serve this image set. The tile client maintains a cache of the previously accessed images and therefore only needs to retrieve the tiles that have been updated since the last interaction with the server.

To solve the above use case, two services are proposed: A tile service with an image service that is internally synchronized. An image set is identified by a collection id. An image set is a list of images and each one having and image id and it is exposed by a image server though an OGC API - Images. A Tile server also exposes the image set as tiles associated to a layer name. Both views of the same dataset are related when the image set collection id and the tile server layer name are the same. Checkpoint ids are used to notify the status of the client cache to the server. The Checkpoint id acts as a filter in retrieval queries, making the server respond with only the tiles updated since the last
interaction. In other words, it allows the server to recognize the client status and to send it the changes to update the status to the current server status. The way the server “recognizes the status of the client” is up to a server developer: it might involve the need to maintain server replicas of content of previous communications to the client. Another way to implement the same functionality is that the service documents (audits) every change in the resource(s) it maintains and assign a checkpoint to each change independently of the client interaction.

Suggested additions, changes and comments on this standard are welcome and encouraged. Such suggestions may be submitted using the online change request form on OGC web site: http://portal.opengeospatial.org/public_ogc/change_request.php

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iv. Submitting organizations

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UAB-CREAF

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Joan Masó, CREAF

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<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Role</th>
</tr>
</thead>
<tbody>
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<td>Joan Maso Pau</td>
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</tbody>
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The draft specification was based on (an sometimes reproduces) previous work of the following people:

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Chapter 1. Scope

This OGC Testbed-15 Engineering Report (ER) provides an approach to a transactional Web Map Tiling Service 2.0 (WMTS-T) by combining an Image Service to manage (retrieve, add, modify or delete) a set of images in a server with a WMTS service that is able to communicate updates within a specified timeframe. Both the Image Service and the WMTS are internally connected. WMTS is not transactional but the transactional capabilities are provided by the Image Service.

This ER presents a proof of concept developed in Testbed-15 and presented in this document in the form of a draft specification. The draft specification is written in the context of the OGC Application Programming Interface (API) effort and abandons the OGC web services style (KVP, SOAP, etc.) to adopt the new OGC Web API style whereby services use a resource-oriented architecture along with the standard web verbs and an OpenAPI description document. The draft specification is documented for consideration by the OGC Standards Program.
Chapter 2. Conformance

If this draft specification progresses within the Standards Program, this section would be populated by the Web Map Service (WMS) Standards Working Group (SWG).
Chapter 3. References

The following normative documents are referenced in this document.

NOTE: Only normative standards are referenced here, e.g. OGC, ISO or other SDO standards. All other references are listed in the bibliography. Example:

• OGC: OGC 17-083r2, OGC Two Dimensional Tile Matrix Set (2019) [http://docs.opengeospatial.org/is/17-083r2/17-083r2.html]

NOTE

This draft specification produced in the Testbed-15 project assumes that an OGC API - Common standard exists. This was a necessary assumption in the Testbed-15 project. However, at the time of finalizing this engineering report an initial draft specification had been produced in the OWS Common SWG. The authors of this document are assuming that some parts of the OGC API - Features standard will form part of a new OGC API - Commons in a near future with almost no variation, but with the text generalized to cover resources types other than features).

NOTE

This draft specification has normative references to the SpatioTemporal Asset Catalog (STAC) specification that has not been vetted and approved by a standards development organization such as the OGC [1]. Actually, the STAC specification is still rapidly evolving and the latest version can be found in https://github.com/radiantearth/stac-spec. As a mitigation, this draft specification reproduces the schemas of the version 0.8. The opinion of the authors of this draft specification is that the OGC API - Images core could be written in a way that is independent from the STAC encoding and an extension can be added to support the STAC encoding. In the Testbed-15 there was no time or the need to do it but a future SWG should consider this as an option.
Chapter 4. Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Standard OGC 06-121r9 [https://portal.opengeospatial.org/files/?artifact_id=38867&version=2] shall apply. In addition, the following terms and definitions apply.

- **changeset**
  an atomic collection of changes to a set or resource in a repository. A changeset contains all recorded local modified resources that lead to current status of the repository from a previous status. The previous status is identified by a checkpoint ID.

- **checkpoint**
  in a situation where the server can update resources and collections with new information, a moment in time when the server exchanges resource information with the client and the client becomes synchronized with the server (i.e. both client and server have a common representation of those resources). A checkpoint is represented by a checkpoint ID that can later be used by a client to request an update of the resources (i.e. a changeset).

- **coordinate reference system**
  coordinate system that is related to an object by a datum (source: ISO 19111:2019)

  **NOTE**
  Geodetic and vertical datums are referred to as reference frames.

  **NOTE**
  For geodetic and vertical reference frames, the object will be the Earth. In planetary applications, geodetic and vertical reference frames may be applied to other celestial bodies.

- **dataset**
  collection of data (source: ISO 19115)

  **NOTE**
  [DCAT] defines 'dataset' as a collection of data, published or curated by a single agent, and available for access or download in one or more formats. The use of 'collection' in the definition from [DCAT] is broader than the use of the term collection in this specification.

- **distribution**
  represents an accessible form of a dataset [DCAT]

  EXAMPLE: a downloadable file, an RSS feed or an API.

- **collection**
  a set of elements 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.
● **element**
  entities that are part of a collection

● **image set**
  list of images with many aspects in common that allows them to be presented as a single one (e.g. as an image mosaic). Commonly they share the same CRS, the same topic (in remote sensing they will share the same sensor and level of processing) and they are from similar times.

● **mosaic**
  a continuous image representation that results from combining all images in an image set

● **portrayal**
  presentation of information to humans (source: ISO 19117)

● **tile**
  a geometric shape with known properties that is the result of the tiling (tessellation) of a plane. A tile consists of a single connected "piece" without "holes" or "lines" (topological disc).

● **tile matrix**
  a grid tiling scheme that defines how space is partitioned into a set of conterminous tiles at a fixed scale (source: OGC 17-083r2).

  NOTE A tile matrix constitutes a tessellation of the space that resembles a matrix in a 2D space characterized by a matrix width (columns) and a matrix height (rows).

● **tile matrix set**
  a tiling scheme composed by collection of tile matrices defined at different scales covering approximately the same area and has a common coordinate reference system (source: OGC 17-083r2).

● **Web API**
  API using an architectural style that is founded on the technologies of the Web [DWBP]

  NOTE Best Practice 24: Use Web Standards as the foundation of APIs [https://www.w3.org/TR/dwbp/#APIHttpVerbs] in the W3C Data on the Web Best Practices provides more detail.

### 4.1. Abbreviated terms

- API Application Programming Interface
- CRS Coordinate Reference System
- OWS OGC Web Services
- STAC SpatioTemporal Asset Catalog
- WCS Web Coverage Service
- WMTS Web Map Tile Service
Chapter 5. Conventions

5.1. Identifiers

The normative provisions in this draft specification are denoted by the URI http://www.opengis.net/spec/ogcapi-images-1/1.0 and http://www.opengis.net/spec/ogcapi-changeset-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. Link relations

To express relationships between resources, RFC 8288 (Web Linking) is used.

The following registered link relation types are used in this document.

- **alternate**: Refers to a substitute for this context.
- **collection**: The target IRI points to a resource which represents the collection resource for the context IRI.
- **describedBy**: Refers to a resource providing information about the link’s context.
- **item**: The target IRI points to a resource that is a member of the collection represented by the context IRI.
- **next**: Indicates that the link’s context is a part of a series, and that the next in the series is the link target.
- **license**: Refers to a license associated with this context.
- **prev**: Indicates that the link’s context is a part of a series, and that the previous in the series is the link target.
  - This relation is only used in examples.
- **self**: Conveys an identifier for the link’s context.
- **service-desc**: Identifies service description for the context that is primarily intended for consumption by machines.
  - API definitions are considered service descriptions.
- **service-doc**: Identifies service documentation for the context that is primarily intended for human consumption.

In addition, the following link relation types are used for which no applicable registered link relation type could be identified.

- **items**: Refers to a resource that is comprised of members of the collection represented by the link’s context.
- **conformance**: Refers to a resource that identifies the specifications that the link’s context conforms to.
• **data**: Indicates that the link’s context is a distribution of a dataset that is an API and refers to the root resource of the dataset in the API.

Each resource representation includes an array of links. Implementations are free to add additional links for all resources provided by the API. For example, an **enclosure** link could reference a bulk download of a collection. Or a **related** link on a feature could reference a related feature.

### 5.3. Use of HTTPS

For simplicity, this document in general only refers to the HTTP protocol. This is not meant to exclude the use of HTTPS and simply is a shorthand notation for “HTTP or HTTPS.” In fact, most servers are expected to use RFC2818 (HTTPS), not RFC2616 (HTTP).

### 5.4. HTTP URIs

This document does not restrict the lexical space of URIs used in the API beyond the requirements of the RFC2616 (HTTP) and RFC3986 (URI Syntax) IETF RFCs. If URIs include reserved characters that are delimiters in the URI subcomponent, these have to be percent-encoded. See Clause 2 of RFC3986 for details.

### 5.5. API definition

#### 5.5.1. General remarks

Good documentation is essential for every API so that developers can more easily learn how to use the API. In the best case, documentation will be available in HTML and in a format that can be processed by software to connect to the API.

This draft specification specifies requirements and recommendations for APIs that share images and to specify changesets and that want to follow a standard way of doing so. In general, APIs will go beyond the requirements and recommendations stated in this draft specification - or other parts of the OGC API family of standards - and will support additional operations, parameters, etc. that are specific to the API or the software tool used to implement the API.

#### 5.5.2. Role of OpenAPI

This document uses OpenAPI 3.0 fragments as examples and to formally state requirements. However, using OpenAPI 3.0 is not required for implementing a server.

Therefore, the **Core** requirements class only requires that an API definition is provided and linked from the landing page.

In this document, fragments of OpenAPI definitions are shown in YAML (YAML Ain’t Markup Language) since YAML was designed to be easier to read than JavaScript Object Notation (JSON) and is typically used in OpenAPI editors. YAML is described by its authors as a human friendly data serialization standard for all programming languages.
5.5.3. References to OpenAPI components in normative statements

Some normative statements (requirements, recommendations and permissions) use a phrase that a component in the API definition of the server must be "based upon" a schema or parameter component in the OGC schema repository.

In the case above, the following changes to the pre-defined OpenAPI component are permitted.

- If the server supports an Extensible Markup Language (XML) encoding, `xml` properties may be added to the relevant OpenAPI schema components.
- The range of values of a parameter or property may be extended (additional values) or constrained (if a subset of all possible values is applicable to the server). An example for a constrained range of values is to explicitly specify the supported values of a string parameter or property using an enum (enumeration).
- The default value of a parameter may be changed or added unless a requirement explicitly prohibits this.
- Additional properties may be added to the schema definition of a Response Object.
- Informative text may be changed or added, like comments or description properties.

For API definitions that do not conform to the OpenAPI Specification 3.0, the normative statement should be interpreted in the context of the API definition language used.

5.5.4. Paths in OpenAPI definitions

All paths in an OpenAPI definition are relative to a base URL of the server.

*Example 1. URL of the OpenAPI definition*

If the OpenAPI Server Object looks like this:

```yaml
servers:
  - url: https://dev.example.org/
    description: Development server
  - url: https://data.example.org/
    description: Production server
```

The path "/mypath" in the OpenAPI definition of a Web API would be the URL `https://data.example.org/mypath` for the production server.

5.5.5. Reusable OpenAPI components

Reusable components for OpenAPI definitions for implementations of OGC APIs are referenced from this document.
Chapter 6. Overview

6.1. Evolution from OGC Web Services

This OGC Testbed-15 Engineering Report defines a draft specification that formalizes the approach that the Testbed-15 participants agreed to for providing a Web Map Tiling Service – transactional capability. In Testbed-15, the WMTS was based on a set of images (e.g. remote sensing scenes) that were the source for the creation of the tiles served by a WMTS implementation. The content of the tiles can change over time. This could result from new scenes being provided by some remote sensing platform. Instead of making the WMTS service (and standard) capable of accepting new tiles as updates (WMTS transactional), the Testbed 15 participants instead decided to opt for pairing a tile service with an image service that are internally synchronized. An image set is exposed by the image server as a list of images that has an id and by the tile server as tiles associated to a layer with the same id. The concept of an image service is new to the emerging suite of OGC APIs.

6.2. Images, Tiles and Changesets

The next two sections specify the OGC API - Images draft specification. The first section describes the core of the service: The operations related to service discovery, API description, collection description, image sets description and operations for retrieving images. The second section describes the mechanisms for adding, updating and deleting images of an image set.

These sections are followed with a discussion and description of the changeset building block. First, a changeset workflow that can be applied to any data service is specified. The draft specification specifies a filter parameter to retrieve only the elements that have changed in a collection. The second following section specifies the way the changeset filter is applied to the OGC API tiles.

6.3. How to approach the OGC API Images

From a client implementation point of view, there are mainly two ways to approach an OGC API.

- Read the landing page, look for links, follow them and discover new links until the desired resource is found;
- Read the API definition document (for example an OpenAPI document) that specifies a list of paths to resources.

Since the first approach requires visiting several resources until the desired resource is finally reached, it is expected to be slower than the second approach. The first approach mimics how the web works and it is only recommended to implementers of very generic exploratory clients. In this approach, many resources in the API include links with rel properties to show the reason for the relation. The following figure illustrates the links.
Figure 1. Resources and relations to them via links

For the second approach, the section OpenAPI Examples will provide some examples of OpenAPI definition documents that enumerate the paths to get to the necessary resources directly [2].

Table 1. Overview of resources and common direct links defined in the OGC API

<table>
<thead>
<tr>
<th>Resource name</th>
<th>Common path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landing page</td>
<td>/</td>
</tr>
<tr>
<td>Conformance declaration</td>
<td>/conformance</td>
</tr>
<tr>
<td>Collections</td>
<td>/collections</td>
</tr>
<tr>
<td>Collection</td>
<td>/collections/{collectionId}</td>
</tr>
<tr>
<td>Tiling Schemas</td>
<td>/tileMatrixSets</td>
</tr>
<tr>
<td>Tiling Schema</td>
<td>/tileMatrixSets/{tileMatrixSetId}</td>
</tr>
<tr>
<td>Map tiles</td>
<td></td>
</tr>
<tr>
<td>Map tiles description</td>
<td>/collections/{collectionId}/map/</td>
</tr>
<tr>
<td><strong>Resource name</strong></td>
<td><strong>Common path</strong></td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Map tiles description collections(^1)</td>
<td>/map/tiles</td>
</tr>
<tr>
<td>Map tile</td>
<td>/collections/{collectionId}/map/{styleId}/tiles/{tileMatrixSetId}/{tileMatrix}/{tileRow}/{tileCol}</td>
</tr>
<tr>
<td>Map tile collections(^1)</td>
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<tr>
<td>Map tile multi-tiles</td>
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<tr>
<td>Map tile multi-tiles collections(^1)</td>
<td>/map/tiles/{tileMatrixSetId}</td>
</tr>
<tr>
<td>Images</td>
<td></td>
</tr>
<tr>
<td>Image set</td>
<td>/collections/{collectionId}/images</td>
</tr>
<tr>
<td>Image</td>
<td>/collections/{collectionId}/images/{imageId}</td>
</tr>
</tbody>
</table>

\(^1\): In the first column of the table, the word "collections" means "from more than one collection"
Chapter 7. Requirements Class "Images Core"

7.1. Overview

<table>
<thead>
<tr>
<th>Requirements Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core</a></td>
</tr>
<tr>
<td>Target type</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
</tbody>
</table>

An API that implements this conformance class provides access to image resources organized in image-sets of a dataset [https://www.w3.org/TR/vocab-dcat/#class-dataset]. In other words, the API is a distribution [https://www.w3.org/TR/vocab-dcat/#class-distribution] of that dataset. An implementation of the OGC API - Tiles draft specification, for example, would be another distribution.

The entry point is a Landing page (path /).

The Landing page provides links to

- the API definition (path /api, link relation service),
- the Conformance declaration (path /conformance, link relation conformance), and
- the Collections (path /collections, link relation data). In this draft specification a collection represents an image set composed by individual images.

The API definition describes the capabilities of the API instance, adopting elements from the OGC API - Common draft specification and adding capabilities that can be used by clients to retrieve images via the API or by development tools to support the implementation of API enabled servers and clients. Accessing the API definition using HTTP GET returns a description of the OGC API - Images instance.

The Conformance declaration states the requirements classes from existing standards or community specifications. These are identified by a URI that the API conforms to. Clients can, but are not required to, use this information. Accessing the Conformance declaration using HTTP GET returns the list of URIs of requirements classes implemented by the OGC API Images.

This draft specification assumes that data is organized into one or more collections. Collections provides information about and access to the collections. Each set of images is represented by a collectionId. The collection can be retrieved as images, tiles or other representations - for example, a coverage (that might provide access to the image set as a mosaic).
This specification reserves the term "collection" for the concept defined in OWS common (OGC 06-121r9) that is closer to the old concept of "layer" in WMS. In the OGC API - Images draft specification, images are organized in image sets (that will not be called collections of images to avoid confusion). An image set is a collection from the OGC API - Commons point of view.

Accessing Collections using HTTP GET returns a response that contains at least the list of collections. Accessing Collections/{collectionId} using HTTP GET returns a description of a collection with an indication if the collection can be retrieved as individual images. For each Collection, a link to metadata about the collection is available (path /collections/{collectionId}) with key information about the collection. This information includes:

- A local identifier for the collection that is unique for the dataset;
- An optional title and description for the collection;
- An optional extent that can be used to provide an indication of the spatial and temporal extent of the collection - typically derived from the data;
- Links to representations of the collections, presented as a single "image".

The Collection resource is available at path /collections/{collectionId}, often with more details than included in the Collections response.

### 7.2. General

<table>
<thead>
<tr>
<th>Requirement 1</th>
<th>/req/images/core/api-common</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The OGC API SHALL comply with the requirements specified in the <a href="http://www.opengis.net/spec/OAPI_Common/1.0/req/core">http://www.opengis.net/spec/OAPI_Common/1.0/req/core</a> and <a href="http://www.opengis.net/spec/OAPI_Common/1.0/req/collections">http://www.opengis.net/spec/OAPI_Common/1.0/req/collections</a> Requirements Classes of the OGC API - Common version 1.0 Standard.</td>
</tr>
</tbody>
</table>

In practice, this means that the landing page and the conformance page follow OGC API - Common core and collections requirements. This standard provides extra additions to the OGC API - Common requirements that are particular to images.

### 7.3. API landing page

The landing page provides links to start exploring the resources offered by the API. The landing page mainly consists of a list of links. The OGC Web Service (OWS) Common Implementation Standard (OGC 06-121r9) already requires some common links that are enough for this draft specification core.

#### 7.3.1. Response

No variations of the landing page are required. With a /collections successful response, the list of
collectionId and links to the /collections/{collectionId} can be retrieved. With a /collections/{collectionId} successful response, and if the collection is available as images, the links to retrieve and manage images can be discovered. Note that other resource types may also be retrieved as collections.

7.4. 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 requirements classes it implements and conforms to.

7.4.1. Response

The conformance page mainly consists of a list of links. OGC API - Common already requires some links.

<table>
<thead>
<tr>
<th>Requirement 2</th>
<th>/req/images/core/conformance-success</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The API conformance path SHALL advertise the images core conformance class as links to <a href="http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core</a>.</td>
</tr>
</tbody>
</table>

In the conformance page (commonly in JSON format) the links are following the link schema defined in the OGC API - Common draft specification. The following is an example fragment of the response of a pure OGC API - Images conformance information page. A server may include conformance to other standards adding new capabilities to the OGC API Images or adding support to other resource types specified in other OGC API standards.

Example 2. Conformance Information Page minimum example

```json
{
    "conformsTo": [
        "http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core",
        "http://www.opengis.net/spec/ogcapi-common-1/1.0/req/collections",
        "http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core"
    ]
}
```

7.5. Collections

This draft specification includes dependencies on OGC API - Common collections. Collections are mandatory in the core of this draft specification because collections are the object that will be included in a tile.

Collections will enumerate the collectionId available in this API as well as basic information about
each collectionId: id, title, description, extent, CRS and links. This common response is considered enough for a general description of the collection.

<table>
<thead>
<tr>
<th>Requirement 3</th>
<th>/req/images/core/ic-md-collection-links</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>For each collection included in the response, a links property of the collection SHALL include a link to the description of the individual collection (relation: item) (in addition to other links specified in OGC API Commons).</td>
</tr>
</tbody>
</table>

More specific details about the collection can be found following the link to the individual collections that follow the pattern /collections/{collectionId}

NOTE: The collectionId can be interpreted as the name of the image set composed by all the images in the collection. It can also be interpreted as the mosaic that can be created by combining all the images in the collection.

7.6. Collection

This draft specification includes dependencies on an OGC API - Common structured collection. The response of the operation is extended with a new link for the images description.

7.6.1. Collection Links

<table>
<thead>
<tr>
<th>Requirement 4</th>
<th>/req/images/core/sic-images-example</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>If the resource can be retrieved as images, a 200-response SHALL include at least a link to the image set description for this resource.</td>
</tr>
<tr>
<td>B</td>
<td>These links SHALL provide a URL with the fragment /images.</td>
</tr>
</tbody>
</table>

7.7. Image set description

The response of the image set description operation provides metadata about the image set (description, extent, license, etc.) as well as the list of links to the individual images currently in the image set. The information of the image set is generated by the server based on internal state of the images. The information can only be retrieved but this core does not provide any mechanism to create, modify or delete it, except the update of the metadata produced as a result of adding individual images.

7.7.1. Operation

<table>
<thead>
<tr>
<th>Requirement 5</th>
<th>/req/images/core/sci-op</th>
</tr>
</thead>
</table>
Every resource available as images SHALL support an operation to retrieve the description of the image set, available as a HTTP GET request to a URI that is composed of two parts: An initial part is the URI of a resource that can be represented as images (e.g. a collection with id /collections/{collectionId}) and the second part follows the pattern /images. Only the resources or collection that supports this operation can be retrieved as images.

Typical resources that can be retrieved as images follow the pattern /collections/{collectionId}. In this case collectionId is expected as a parameter.

### 7.7.2. Parameter collectionId

If the resource is a collection, a collectionId parameter is expected. This parameter is described in the OGC API - Common draft specification.

### 7.7.3. Parameters limit and offset

These parameters provide a mechanism to limit the number of images linked to an image-set and to allow for paging the results in case there are too many images. These parameters are described in the OGC API - Common draft specification.

### 7.7.4. Parameters bbox and datetime

These parameters provide a mechanism to limit the bounding box and temporal extent of images linked to image-set. These parameters are described in the OGC API - Common.

### 7.7.5. Response

A successful response of an image-set request for a collection that can be retrieved as images is a data structure describing the image set and listing the available images.

<table>
<thead>
<tr>
<th>Requirement 6</th>
<th>/req/images/core/sci-stac-col</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The content of the response of a successful execution SHALL be a JSON file following the STAC collection specification and schema.</td>
</tr>
<tr>
<td>B</td>
<td>The rel value item SHALL be used to enumerate the image links in and image set</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation 1</th>
<th>/rec/images/core/sci-stac-col-link-image</th>
</tr>
</thead>
</table>
The link to an individual image SHOULD be composed of two parts: An initial part is the URI of a resource that can be represented as images (e.g. a collection with id /collections/{collectionId}) and the second part follows the pattern /images/{imageId}.

The STAC collection specification is still evolving. At the time of writing this draft specification, the version available is 0.8.0. That version satisfied TestBed-15 requirements. New versions may appear in the future. This draft specification does not specify any requirement about the version of the STAC collection that should be used.

For the purpose of facilitating the elaboration of OpenAPI document, the OpenAPI 3.0 version of the schema to validate the response should also be included as part of the OpenAPI document. A STAC schema adapted to the OpenAPI 3.0 schema is provided in the annex STAC Schemas and examples.

The following response illustrates a valid STAC collection document version 0.8.0

Example 3. Example of the response to an image set request that follows the STAC collection format

```json
{
  "stac_version": "0.8.0",
  "stac_extensions": [],
  "id": "Daraa_mosaic_2019",
  "title": "Imagery from Daraa 2019",
  "description": "Catalog of imagery in coverage Daraa_mosaic_2019",
  "links": [
    {
      "rel": "self",
      "href": "https://tb15.cubewerx.com/cubewerx/cubeserv/op-stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images"
    },
    {
      "rel": "root",
      "href": "https://tb15.cubewerx.com/cubewerx/cubeserv/op-stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images"
    },
    {
      "rel": "item",
      "href": "https://tb15.cubewerx.com/cubewerx/cubeserv/op-stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images/23"
    },
    {
      "rel": "item",
      "href": "https://tb15.cubewerx.com/cubewerx/cubeserv/op-stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images/5"
    }
  ],
  "summaries": {},
  "keywords": "Daraa"
}
```
7.8. Image description

The response to an Image description operation provides metadata about the image (description, extent, license, etc.) as well as a list of links to the main file of the image and all additional files that may accompany the image. The information about the image is generated by the server based on internal metadata about the image that is stored by the server during the addition or modification of an image in the image set. A way to submit or alter the image description is not provided by this draft specification. The image can also be deleted from the image set.

7.8.1. Operation

| Requirement 7 | /req/images/core/scii-op |
An image set SHALL support an operation to retrieve the
description of an image that is part of an image set, available as a
HTTP GET request to a URI provided as part of the links section
present in the image set description.

Typical resources that can be retrieved as images follow the pattern /collections/{collectionId}. In this case, collectionId is expected as a parameter.

The link to an individual image is normally composed of two parts: The first part is the URI of a resource that can be represented as images (e.g. a collection with id /collections/{collectionId}) and the second part follows the pattern /images/{imageId}. In this case imageId is expected as a parameter.

### 7.8.2. Parameter `collectionId`

If the resource is a collection, a collectionId parameter is expected. This parameter is described in the OGC API - Common draft specification.

### 7.8.3. Parameter `imageId`

If the resource follows the URI template recommendations, an imageId parameter is expected. The value of this parameter is the final name in the image path.

### 7.8.4. Response

A successful response to an image request is a data structure describing the image and linking to it. Sometimes an image is formed by more than one file (in here we call them parts of the image) and they are listed as other files related with the image.

<table>
<thead>
<tr>
<th>Requirement 8</th>
<th>/req/images/core/sci-stac-item</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>The content of the response of a successful execution SHALL be a JSON file following the extension of the STAC item specification for images (that extends the original STAC item schema).</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>The image parts (files) SHALL be listed in the assets property of the response document. The main file of the image SHALL be included as a valid URL in the href property of main object in the assets object. The URLs of the other parts of an image might be contained in the href property in other objects of the assets object.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation 2</th>
<th>/rec/images/core/sci-stac-item</th>
</tr>
</thead>
</table>
The properties object for the stac-item (that is inherited from GeoJSON) SHOULD have two properties bbox and crs that contains the native bounding box in the native CRS that represents the DomainSet of the Rangeset of values in the image (Domainset and Rangeset are concepts precisely defined for regular grids in the OGC CIS standard).

The properties element for the stac-item (that is inherited from GeoJSON) SHOULD have a property nominalResM that contains the nominal resolution of the data (expressed in meters).

The properties element for the stac-item (that is inherited from GeoJSON) SHOULD have a property cloudCover that contains the approximated percentage of the data that is covered of shadowed by clouds.

As explained before for the STAC collection, the STAC item specification is also still evolving. This draft specification does not specify any requirement about the version of the STAC item that should be used. For the purpose of facilitating the elaboration of an OpenAPI document, the OpenAPI 3.0 version of the schema to validate the response should also be included as part of the OpenAPI document. The STAC item schema adapted to the OpenAPI 3.0 schema is provided in STAC Schemas and examples:

The following response illustrates a valid STAC item document, based on version 0.8.0 of the STAC specification.

Example of the response to a image request that follows the STAC item format

```json
{
  "type": "Feature",
  "geometry": {
    "type": "Polygon",
    "coordinates": [
      [
        [35.99601746, 32.57551892],
        [36.08110064, 32.57551892],
        [36.08110064, 32.64790382],
        [35.99601746, 32.57551892]
      ]
    ]
  }
}
```
"properties": {
  "datetime": "2019-05-21T19:36:44Z",
  "title": "One image",
  "license": "proprietary",
  "providers": [
    {
      "name": "NGA",
      "description": "National Geospatial-Intelligence Agency",
      "roles": [
        "producer"
      ],
      "url": "https://www.nga.mil"
    }
  ],
  "created": "2019-06-21T19:36:44Z",
  "updated": "2019-08-21T19:36:44Z",
  "nativeBbox": {
    "bbox": [
      780349.63,
      6556104.14,
      803726.72,
      6582470.15
    ],
    "crs": "http://www.opengis.net/def/crs/EPSG/0/3857"
  },
  "nominalResM": 0.5332085767116562,
  "cloudCover": 80.5
},
"id": "LC81530252014153LGN00",
"links": [
  {
    "rel": "self",
    "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00.json"
  },
  {
    "rel": "alternate",
    "href": "https://landsatonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00",
    "type": "text/html"
  },
  {
    "rel": "root",
    "href": "https://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00.json"
  }]}
"B5": {
  "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B5.TIF",
  "type": "image/vnd.stac.geotiff",
  "eo:bands": [
    4
  ]
},
"B6": {
  "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B6.TIF",
  "type": "image/vnd.stac.geotiff",
  "eo:bands": [
    5
  ]
},
"B7": {
  "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B7.TIF",
  "type": "image/vnd.stac.geotiff",
  "eo:bands": [
    6
  ]
},
"B8": {
  "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B8.TIF",
  "type": "image/vnd.stac.geotiff",
  "eo:bands": [
    7
  ]
},
"B9": {
  "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B9.TIF",
  "type": "image/vnd.stac.geotiff",
  "eo:bands": [
    8
  ]
},
"B10": {
  "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B10.TIF",
  "type": "image/vnd.stac.geotiff",
  "eo:bands": [
    9
  ]
},
"B11": {
  "href": "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B11.TIF",
  "type": "image/vnd.stac.geotiff",
  "eo:bands": [
    10
  ]
}
"type": "image/vnd.stac.geotiff",
"eo:bands": [
  10
]
},
"collection": "Landsat8",
"bbox": [
  35.99601745605469,
  32.57551891751058,
  36.08110063620433,
  32.64790382025549
]
Chapter 8. Requirements Class "Images Transactional"

8.1. Overview

<table>
<thead>
<tr>
<th>Requirements Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-images-1/1.0/req/transactional">http://www.opengis.net/spec/ogcapi-images-1/1.0/req/transactional</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target type</th>
<th>Web API</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dependency</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 2616 (HTTP/1.1)</td>
</tr>
<tr>
<td>RFC 2818 (HTTP over TLS)</td>
</tr>
<tr>
<td>RFC 3339 (Date and Time on the Internet: Timestamps)</td>
</tr>
<tr>
<td>RFC 8288 (Web Linking)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependency</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core</a></td>
</tr>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-common-1/1.0/req/collections">http://www.opengis.net/spec/ogcapi-common-1/1.0/req/collections</a></td>
</tr>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core</a></td>
</tr>
</tbody>
</table>

The following API definition extends the OGC API - Images core to support the creation, update and deletion of images from an image set.

8.2. API landing page

The landing page provides links to start exploring the resources offered by the API. The landing page mainly consists of a list of links. OGC API - Common specifies common links that are required for the API image core.

8.2.1. Response

There are no required variations to the landing page.

8.3. 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 server API must declare the requirements classe(s) it implements and conforms to.

8.3.1. Response

The conformance page mainly consists of a list of links. OGC API - Common already requires some links that are visible in the next example.

<table>
<thead>
<tr>
<th>Requirement 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>/req/images/transactional/conformance-success</td>
</tr>
</tbody>
</table>
The OGC API - Images conformance path SHALL advertise the images transactional conformance class as links to http://www.opengis.net/spec/ogcapi-images-1/1.0/req/transactional.

In the conformance page (commonly in JSON format) the links follow the link schema defined in the OGC API - Common draft specification. The following is an example fragment of the response of an OGC API - Images conformance information page.

Example 4. Conformance Information Page fragment

```json
{
  "conformsTo": [
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core",
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/req/collections",
    "http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core",
    "http://www.opengis.net/spec/ogcapi-images-1/1.0/req/transactional"
  ]
}
```

8.4. Image upload

There are two ways to upload an image to an image set based on the use of the HTTP POST and PUT verbs. The second way is also useful to modify an existing image.

To determine if the user has the necessary privileges to add an image to an existing image-set or to modify an image that is already part of an image set, use the OPTIONS verb to check the operations available to the user. For example, to determine if an image can be added to an image-set, an OPTIONS request to the image set URI should be performed. To determine if an image can be modified, an OPTIONS request to the image URI should be performed.

8.4.1. Operation

<table>
<thead>
<tr>
<th>Requirement 10</th>
<th>/req/images/transactional/sci-post-op</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Every image URI SHALL support the HTTP OPTIONS operation</td>
</tr>
<tr>
<td>B</td>
<td>An image set that accepts the addition of new images SHALL advertise support of a POST operation as part of the headers (&quot;Accept&quot; header) of a successful response to a request OPTIONS operation to the URI of the image set.</td>
</tr>
</tbody>
</table>
If the OPTIONS operation to the image set includes POST, the image set URI SHALL accept a POST operation to new image to an image set.

As a result of a successful operation, the image SHALL become available as a new image of the image set.

8.4.2. Parameter collectionId

If the resource is a collection, a collectionId parameter is expected. This parameter is described in the draft OGC API – Common specification.

8.4.3. Payload

<table>
<thead>
<tr>
<th>Requirement 11</th>
<th>/req/images/transactional/sci-post-payload</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The payload sent in the body of the HTTP POST request SHALL be a new image compatible with the image set. The selected media type SHALL be capable of containing the image values as well as all mandatory metadata in the STAC item schema.</td>
</tr>
</tbody>
</table>

Examples of valid media types are a geo-enabled standalone file (e.g. image/tiff; application=geotiff.) or a multipart format that includes a part with value and auxiliary parts with the metadata (application/vnd.ogc.multipart;container=application/x-zip-compressed;images=image/tiff).

8.4.4. Response

A successful response to an image upload will return an HTTP Status Code 201 and will contain the URL to retrieve the new image created.

<table>
<thead>
<tr>
<th>Requirement 12</th>
<th>/req/images/transactional/sci-uri</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The Location header in the response SHALL contain the URI to the new image created in the server.</td>
</tr>
</tbody>
</table>

The HTTP status response codes are specified in the HTTP standard. The specific recommended usage in the OGC APIs can be found in the OGC API - Common draft specification.
8.4.5. Operation

<table>
<thead>
<tr>
<th>Requirement 13</th>
<th>/req/images/transactional/scii-put-op</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Every image URI SHALL support the HTTP OPTIONS operation.</td>
</tr>
<tr>
<td>B</td>
<td>An image that can be modified in the server SHALL advertise support to a PUT operation as part of the headers (&quot;Accept&quot; header) of a successful response to a request OPTIONS operation to the URI of the image.</td>
</tr>
<tr>
<td>C</td>
<td>If the OPTIONS operation to the image includes PUT, the image URI SHALL accept a PUT operation to a new or modified image in the image set.</td>
</tr>
<tr>
<td>D</td>
<td>If the image is new, it SHALL become available as a new image of the image set. If the image was already in the image set, the server SHALL delete the old image and replace it with the new image.</td>
</tr>
</tbody>
</table>

Typical resources can be uploaded as images in image-sets that follow the pattern /collections/{collectionId}. In this case collectionId is expected as a parameter.

The link to an individual image is normally comprised of two parts: An initial part that is the URI of a resource that can be represented as images (e.g. a collection with id /collections/{collectionId}) and the second part that follows the pattern /images/{imageId}. In this case imageId is expected as a parameter.

8.4.6. Parameter collectionId

If the resource is a collection, a collectionId parameter is expected. This parameter is described in OGC API - Common.

8.4.7. Parameter imageId

If the resource follows the URI template recommendations, an imageId parameter is expected. The value of this parameter is the final name in the image path.

8.4.8. Request payload

<table>
<thead>
<tr>
<th>Requirement 14</th>
<th>/req/images/transactional/scii-put-payload</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The payload sent in the body of the HTTP PUT request SHALL be a new image compatible with the image set. The selected media type SHALL be capable of containing the image values as well as all mandatory metadata in the STAC item schema.</td>
</tr>
</tbody>
</table>
Examples of valid media types are a geo-enabled standalone file (e.g. image/tiff; application=geotiff) or a multipart format that includes a part with value and auxiliary parts with the metadata (application/vnd.ogc.multipart;container=application/x-zip-compressed;images=image/tiff).

8.4.9. Response

A successful response to an image upload will return a HTTP Status Code 201 if the resource does not exist or an HTTP Status Code 200 if the resource has been modified.

8.4.10. Operation

<table>
<thead>
<tr>
<th>Requirement 15</th>
<th>/req/images/transactional/scii-delete-op</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>An image that can be deleted from the server SHALL advertise support for a DELETE operation as part of the headers (&quot;Accept&quot; header) of a successful response to a request OPTIONS operation to the URI of the image.</td>
</tr>
<tr>
<td>B</td>
<td>If the OPTIONS operation to the image includes DELETE, the image URI SHALL accept a DELETE operation to an existing image in the image set.</td>
</tr>
<tr>
<td>C</td>
<td>As a result of a successful operation, the server SHALL remove the image from the image-set.</td>
</tr>
</tbody>
</table>

Typical resources that can be retrieved as images follow the pattern /collections/{collectionId}. In this case, collectionId is expected as a parameter.

The link to an individual image is normally comprised of two parts: The first part is the URI of a resource that can be represented as images (e.g. a collection with id /collections/{collectionId}) and the second part follows the pattern /images/{imageId}. In this case, imageId is expected as a parameter.

8.4.11. Parameter collectionId

If the resource is a collection, a collectionId parameter is expected. This parameter is described in OGC API - Common.

8.4.12. Parameter imageId

If the resource follows the URI template recommendations, an imageId parameter is expected. The value of this parameter is the final name in the image path.

8.4.13. Response

A successful response to an image deletion will return a HTTP Status Code 200
Chapter 9. Requirement Class "Changeset core"

9.1. Overview

<table>
<thead>
<tr>
<th>Requirements Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core</a></td>
</tr>
<tr>
<td>Target type</td>
</tr>
<tr>
<td>Web API</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
<tr>
<td>RFC 2616 (HTTP/1.1)</td>
</tr>
<tr>
<td>RFC 2818 (HTTP over TLS)</td>
</tr>
<tr>
<td>RFC 3339 (Date and Time on the Internet: Timestamps)</td>
</tr>
<tr>
<td>RFC 8288 (Web Linking)</td>
</tr>
<tr>
<td>Dependency</td>
</tr>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core</a></td>
</tr>
</tbody>
</table>

The "Changeset core" is an extension building block to the OGC API that is applicable to any data resource that adds a mechanism to request from a server changes in a resource collection since a previous checkpoint. There is no HTTP verb that allows for a partial retrieval of a collection resource, so this capability is implemented as a GET request but is in fact as a partial GET.

At some point in time, the client will request a resource collection and receive that collection with a checkpoint identifier. At a later date and time, the client may send a request for updates and notify the server about the original checkpoint associated with the client status (that is short identifier for the resources the client already knows). The server will then inform the client about the changes in the resources up to now and communicate the current checkpoint. The client can then apply the update and subsequently update its local copy of the resources. Checkpoint identifiers should be considered as unsorted strings and the client should not make any assumption on the order of IDs based on the characters present (despite the fact that some servers could implement checkpoint identifiers as incremental numbers for convenience). This specification does not provide any mechanism to recover a previous status from the server; the changeset mechanism only provides the update from a known checkpoint to the present server status.

Checkpoints should be used with care if a complete synchronization of changes between client and server is required. For example, if the client requests changes using a checkpoint with a spatial filter or a priority filter, the client receives a new checkpoint that is only useful with a follow up request that uses the same filter. If the client intends to request changes using a less restrictive filter, the client should use an older checkpoint to be sure that no changes are lost.

While dealing with atomic resources, consider reusing e-tags to detect changes on cached versions of them as defined in https://tools.ietf.org/html/rfc7232. The e-tag mechanism permits the client to provide a fast, unmodified response for the case in which the resource has not changed. If the resource has been modified, that resource is completely downloaded. The e-tag mechanism works well in "all-or-nothing" situations, but it is not suitable for a collection resource when only some elements of the collection are updated. This requirement class specifies the capability for partial updates to a collection and the server will only retrieve the resource completely if all its parts have
In practice, the above requirement dictates that the landing page and the conformance page follow the OGC API - Common requirements. This draft specification defines extensions to the OGC API - Common requirements that are particular to changesets.

### 9.3. API landing page

The changeset API has been designed using query parameters that can potentially be added to any relevant URL. The landing page provides links to start exploring the resources offered by the API but does not expose checkpoints. The landing page mainly consists of a list of links. OGC API - Common already requires a fix set of common links that are enough for this core (see the OGC API - Common for details).

#### 9.3.1. Response

There are no required variations to the landing page.

### 9.4. 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 Changeset API has to declare the requirements classes it implements and conforms to.

#### 9.4.1. Response

The conformance page mainly consists of a list of links. OGC API - Common specifies required links for any OGC API instance.

<table>
<thead>
<tr>
<th>Requirement 17</th>
<th>/req/changeset/core/conformance-success</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The API conformance path SHALL advertise the changeset core conformance class as links to <a href="http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core</a>.</td>
</tr>
</tbody>
</table>

On the conformance page (commonly in JSON format), the links follow the link schema defined in
OGC API – Common. The following is an example fragment of the response of an implementation of the OGC API – Map draft specification and an OGC API - Tiles draft specification (also developed in Testbed-15) conformance information page with changeset support.

**Example 5. Conformance Information Page fragment**

```json
{
  "conformsTo": [
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core",
    "http://www.opengis.net/spec/ogcapi-common-1/1.0/req/collections",
    "http://www.opengis.net/spec/ogcapi-maps-1/1.0/req/core",
    "http://www.opengis.net/spec/ogcapi-maps-1/1.0/req/styles",
    "http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/core",
    "http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core",
  ]
}
```

### 9.5. Resource retrieval

#### 9.5.1. Headers

A header in the response of a resource retrieval is added to a successful GET request with the checkpoint. This header will be added to a successful response of complete GET request of with a checkpoint parameter.

<table>
<thead>
<tr>
<th>Requirement 18</th>
<th>/req/changeset/core/resource-success</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The body of a successful response SHALL include a header x-checkpoint with the value of the current server checkpoint.</td>
</tr>
</tbody>
</table>

This is necessary for the client to be able to formulate a changeset update request later.

### 9.6. Changeset extra parameters

A resource retrieval GET request can have additional query parameters to specify a filter to get only the changes in a resource collection from the last client request. The client saves checkpoint information associated with the resources it has saved or cached and the client can communicate this information to the server in a follow up request. The server will be able to know what elements the client has and deliver only the updated elements (and the deleted elements).

For a low connectivity environment, a parameter is used to select the priority level of the update changes and request only the most significant changes.

An additional parameter allows selecting the amount of content and the format of the response.
## 9.6.1. Parameter Checkpoint

<table>
<thead>
<tr>
<th>Requirement 19</th>
<th>/req/changeset/core/cp-checkpoint-definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>The operation SHALL support an optional parameter <code>checkpoint</code> with the following characteristics (using an OpenAPI Specification 3.0 fragment)</td>
</tr>
</tbody>
</table>
|                | ```
|                | name: checkPoint
|                | in: query
|                | required: false
|                | schema:
|                | type: string
|                | ``` |
| **B**          | If the parameter is not specified in the request, the response SHALL contain all changes since auditing began. |

## 9.6.2. Parameter priority

<table>
<thead>
<tr>
<th>Requirement 20</th>
<th>/req/changeset/core/cp-priority-definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>The operation SHALL support an optional parameter <code>priority</code> with the following characteristics (using an OpenAPI Specification 3.0 fragment)</td>
</tr>
</tbody>
</table>
|                | ```
|                | name: priority
|                | in: query
|                | required: false
|                | style: form
|                | explode: false
|                | schema:
|                | type: string
|                | default: all
|                | enum:
|                | - low
|                | - medium
|                | - high
|                | - all
|                | example: high
<p>|                | ``` |
| <strong>B</strong>          | If the parameter is not specified in the request, the response SHALL contain all changes whatever their priority. |</p>
<table>
<thead>
<tr>
<th>Requirement 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>/req/changeset/core/cp-changesettype-definition</td>
</tr>
</tbody>
</table>

| A | The operation SHALL support an optional parameter changeSetType that determines the type of the response and with the following characteristics (using an OpenAPI Specification 3.0 fragment) and determines the type of the response |
|   | name: changeSetType |
|   | in: query |
|   | required: false |
|   | style: form |
|   | explode: false |
|   | schema: |
|   |   type: string |
|   |   default: full |
|   |   enum: |
|   |     - summary |
|   |     - full |
|   |     - package |
|   | example: full |

| B | If the value of the changeSetType parameter is set to full or if the parameter is not specified in the request, the server SHALL return the complete changeSet file (with the changes embedded in the document) following the changeSet schema. |

| C | If the value of the changeSetType parameter is set to summary the server SHALL return a document with the summary of the changes. The summary SHALL follow the changeSetSummary schema. The server will not return the actual representation of the changes. |

| D | If the value of the changeSetType parameter is set to package the server SHALL return a package (e.g. a ZIP file) that will include a document with the summary of the changes (the summary follows the changeSetSummary schema) (with no actual changes embedded) and the changes themselves as separated parts in the package. Use this value for requesting changes for tiled resources. |

### 9.7. Changeset response
### 9.7.1. Changeset response with changes

A successful response to a resource request that has the checkpoint query filter will change to a format that contains a changeSet report and eventually the relevant changes.

<table>
<thead>
<tr>
<th>Requirement 22</th>
<th>/req/changeset/core/cp-success</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A successful execution of the operation that has found changes SHALL be reported as a response with a HTTP status code 200.</td>
</tr>
<tr>
<td>B</td>
<td>If the <code>checkPoint</code> property is present in the response, it SHALL contain the checkpoint value from which new changes are requested (not the new checkpoint).</td>
</tr>
<tr>
<td>C</td>
<td>The response SHALL contain a property <code>summaryOfChangedItems</code> containing a count of changes corresponding to each specific priority label.</td>
</tr>
<tr>
<td>D</td>
<td>If the <code>extentOfChangedItems</code> property is present in the response, it SHALL contain a list with one or more of bounding boxes affected by changes produced and in which CRS the coordinates of the bounding boxes are produced.</td>
</tr>
<tr>
<td>E</td>
<td>If the <code>numberOfReturnedItems</code> property is present in the response, it SHALL contain the number of changed items that are presented in the response.</td>
</tr>
<tr>
<td>F</td>
<td>If the <code>changedItems</code> property is present in the response, it SHALL contain a list with the new or modified resources (embedded or linked).</td>
</tr>
<tr>
<td>G</td>
<td>If the <code>deletedItems</code> property is present in the response, it SHALL contain a list of identifiers of deleted resources.</td>
</tr>
</tbody>
</table>
If a summary of changes has been requested, the content of that response SHALL contain a changeSetSummary report based upon the following OpenAPI 3.0 schema:

```json

```changeSetSummary``

description: A document containing a summary of the updates since a specified checkpoint
type: object
required:
- summaryOfChangedItems
properties:
  summaryOfChangedItems:
    description: a per-priority list of change counts
type: array
items:
  description: a count of changes corresponding to a specific priority label
type: object
required:
- priority
- count
properties:
  priority:
    description: the priority label
type: string
count:
    description: the count of changes tagged with the corresponding priority
    type: integer
example:
- priority: high
count: 2
- priority: medium
count: 4
- priority: low
count: 67
```
If a changes report has been requested, the content of that response SHALL contain a changeSet report based upon the following OpenAPI 3.0 schema:

```json
{
  "title": "changeSet",
  "description": "A document containing the updates since a specified checkpoint",
  "allOf": [
    {"$ref": "#/components/schemas/changeSetSummary"},
    {"type": "object",
      "properties": {
        "checkPoint": {
          "description": "the checkpoint value from which new changes are requested. This checkpoint is part of the request to get this file."
        },
        "extentOfChangedItems": {
          "description": "extent of the new, changed or deleted items"
        }
      }
    }
  ]
}
```

```json
{
  "checkPoint": "cp143756",
  "extentOfChangedItems": {
    "bbox": {
      "type": "array",
      "items": {
        "$ref": "https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/bbox"
      }
    },
    "crs": {
      "$ref": "https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/crs"
    },
    "numberOfReturnedItems": {
      "description": "the number of changed items that are presented in the response; this may be less than the total number of changes"
    }
  }
}
```

```json
{
  "changedItems": {
    "description": "a list of new or modified resources. Useful for features. Not recommended for tiles"
  }
}
```

```json
{
  "type": "array",
  "items": {
    "description": "a representations of or reference to the changed resource; e.g. a GeoJSON-encoded feature"
  }
}
```

```json
{
  "type": "object",
  "required": [
    "bbox",
    "crs",
    "numberOfReturnedItems",
    "changedItems"
  ]
}
```
9.7.2. Changeset response with no changes

<table>
<thead>
<tr>
<th>Requirement 23</th>
<th>/req/changeset/tiles/cp-not-modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A successful execution of the operation that has NOT found changes SHALL be reported as a response with a HTTP status code 304.</td>
</tr>
</tbody>
</table>

```json
exports:
  - type: object
  - $ref: https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link
    example:
      - priority: high
        items: []
      - priority: medium
        items: []

deletedItems:
  description: a list of identifiers of deleted resources. Useful for features. Not recommended for tiles.
  type: array
  items:
    description: the identifier of a deleted feature
    type: object
    required:
    - items
    properties:
      priority:
        description: a priority label
        type: string
        items:
          type: array
          items:
            type: string

example:
  - priority: medium
    items:
      - "collections/BUILDINGS/items/F4674"
      - "collections/BUILDINGS/items/F37465819"
```
Chapter 10. Requirement Class "Changeset tiles"

10.1. Overview

<table>
<thead>
<tr>
<th>Requirements Class</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/tiles">http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/tiles</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target type</th>
<th>Web API</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency</td>
<td><a href="http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/core</a></td>
</tr>
<tr>
<td>Dependency</td>
<td><a href="http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core">http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core</a></td>
</tr>
</tbody>
</table>

This extension describes specific requirements for tiles in a changeSet. This class extends:

- "http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/multitiles",
- "http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/cols-multitiles" and
- "http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core".

10.2. API landing page

There are no required variations to the landing page.

10.3. Declaration of conformance classes

10.3.1. Response

The conformance page mainly consists of a list of links. OGC API - Common specifies required links.

<table>
<thead>
<tr>
<th>Requirement 24</th>
<th>/req/checkpoint/tiles/conformance-success</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The API conformance path SHALL advertise the capability of generating tiles from multiple collections adding the conformance class for this capability as a link to <a href="http://www.opengis.net/spec/ogcapi-checkpoint-1/1.0/req/tiles">http://www.opengis.net/spec/ogcapi-checkpoint-1/1.0/req/tiles</a>.</td>
</tr>
</tbody>
</table>

On the conformance page (commonly in JSON format), the links follow the link schema defined in OGC API – Common. The following is an example fragment of the response to an OGC API -Tiles draft specification (also developed in Testbed-15) conformance information page request:
10.4. Multi-tiles operation returning a changeset

A changeset is encoded as a list of tiles that have been affected by changes. The OGC API – Tiles draft specification provides a mechanism to request more than one tile in a single operation. The result is a multi-tile format that warps the tiles in a single package. The same mechanism can be adapted to return one the tiles affected by changes since the last checkpoint.

The multi-tiles operation is applied on top of the requirements class "http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/multitiles" or "http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/cols-multitiles". The parameters defined in "http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core" are added to the parameters defined for multi-tiles or cols-multitiles (multi-tiles of tiles from multiple collections). For requesting changesets of tiles there are some restrictions to the parameters defined in the OGC API - Changeset core that are described in this section.

For completeness, relevant parameters in the OGC API - Tiles multi-tiles are reviewed here.

10.4.1. Parameter priority

This parameter is defined in the OGC API - Changeset core. The use of priority makes sense for feature-based data where changes in some elements such as main roads or bridges may be considered more important than paths or buildings and therefore have high priority for an update. For tiles, this parameter usage is less obvious whether there is applicability. There is still a use case for imagery-based map tiles where this parameter could be of use. In a set of images that have been photo-interpreted, there could be annotations that are attached to the imagery that reveal places that are considered of higher importance (e.g. detection of strategic infrastructures or military arsenals) that then have a higher priority.

The meaning of the priority levels for tiles is left undefined in this draft specification and the parameter can be ignored by clients and services.
10.4.2. Parameter multiTileType

This parameter is defined in OGC API - Tiles multitiles. Of the three possible values defined in the original draft specification, only *full* is relevant here.

<table>
<thead>
<tr>
<th>Requirement 25</th>
<th>/req/changset/tiles/REQ_cp-multitiletype</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Clients and services SHALL ignore the parameter <em>multiTileType</em> and behave as if the value of the parameter is <em>full</em>.</td>
</tr>
</tbody>
</table>

10.4.3. Parameter changeSetType

<table>
<thead>
<tr>
<th>Requirement 26</th>
<th>/req/changset/tiles/cp-changesettiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Clients and services SHALL ignore the parameter <em>changeSetType</em> and behave as if the value of the parameter is <em>package</em>.</td>
</tr>
</tbody>
</table>

Note that the multi-tile operation with the Checkpoint parameter has a different output than the "pure" multi-tile operation. In practice, this means that the parameter multiTileType and changeSetType takes precedence.

10.5. Changeset response

The Changeset report is the one defined in the core but with the addition of an extra element to document the scale range affected by the changes.

<table>
<thead>
<tr>
<th>Requirement 27</th>
<th>/req/checkpoint/tiles/cp-success</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>If the changes in the tiles only affect a range of scales, a <em>scalesOfChangedItems</em> property SHALL be present in the changeset in the request indicating the interval of scales affected by changes. If this parameter is not included, all scales that are affected by changes.</td>
</tr>
<tr>
<td>B</td>
<td>If the <em>extentOfChangedItems</em> property is present in the response the CRS of the coordinates SHALL be the same as the TileMatrixSet.</td>
</tr>
</tbody>
</table>
When the `changeSetType` parameter forces a response using the `changeSet` schema, the content of that response SHALL use the `changeSetTiles` schema instead (that extends `changeSet` by adding a scale interval). The `changeSetTiles` OpenAPI 3.0 follows the schema:

```json
allOf:
  - $ref: '#/components/schemas/changeSet'
  - type: object
    properties:
      scalesOfChangedItems:
        type: object
        required:
          - minScaleDenominator:
          - maxScaleDenominator:
        properties:
          minScaleDenominator:
            type: number
            format: double
          maxScaleDenominator:
            type: number
            format: double
```

When a package is being returned and the package format supports expressing file paths of its parts (such as a ZIP file), each tile in the package SHALL have a path following the template: `{tileMatrixSetId}/{tileMatrix}/{tileRow}/{tileCol}.{file-extension}`. `{file-extension}` is the file extension that corresponds to the media type (e.g “jpg” for image/jpeg).
Appendix A: Abstract Test Suite


**NOTE**
This section is intentionally not provided in this Engineering Report. It should be expanded by a SWG.
Appendix B: STAC Schemas and examples

The STAC specification is still evolving. At the time of writing this standard, the version available was 0.8.0 and it satisfied the Testbed-15 requirements. New versions may appear in the future. This draft specification does not specify any requirement about the version of the STAC that should be used.

B.1. STAC collection schema

For the purpose of facilitating the elaboration of OpenAPI document, the OpenAPI 3.0 version of the schema to validate the response should also be included as part of the OpenAPI document. The original schema can be found in https://github.com/radiantearth/stac-spec/blob/master/collection-spec. The STAC collection schema adapted to the OpenAPI 3.0 schema is provided here:

```json

    title: STAC Collection Specification
    description:
    This object represents Collections in a SpatioTemporal Asset Catalog. Stac Collection is described in https://github.com/radiantearth/stac-spec/blob/master/collection-spec/collection-spec.md
    This schema is a replica of https://raw.githubusercontent.com/radiantearth/stac-spec/master/collection-spec/json-schema/collection.json
    type: object
    allOf:
        - $ref: '#/components/schemas/stacCatalogue'
        - title: STAC Collection
          description: These are the fields specific to a STAC Collection. All other
          fields
            are inherited from STAC Catalog.
          type: object
          required:
          - license
          - extent
          properties:
            stac_extensions:
              title: STAC extensions
              type: array
              uniqueItems: true
              items:
                anyOf:
                - title: Reference to a JSON Schema
                  type: string
                  format: uri
                - title: Reference to a core extension
                  type: string
                  enum:
                  - asset
                  - checksum
                  - scientific
              example: []
```
keywords:
  title: Keywords
  type: array
  items:
    type: string
    example: Daraa

version:
  title: Collection Version
  type: string
  example: 1.0.0

license:
  title: Collection License Name
  type: string
  example: proprietary

providers:
  $ref: '#/components/schemas/stacProviders'

extent:
  title: Extents
  type: object
  required:
  - spatial
  - temporal
  properties:
    spatial:
      title: Spatial extent object
      type: object
      required:
      - bbox
      properties:
        bbox:
          title: Spatial extents
          type: array
          minItems: 1
          items:
            title: Spatial extent
            type: array
            minItems: 4
            maxItems: 6
            items:
              type: number
              example:
                bbox:
                - 35.99601745605469
                - 32.50426061084722
                - 36.08110063620433
                - 32.72028872300039

    temporal:
      title: Temporal extent object
      type: object
      required:
      - interval
properties:
  interval:
    title: Temporal extents
    type: array
    minItems: 1
    items:
      title: Temporal extent
      type: array
      minItems: 2
      maxItems: 2
      items:
        type:
        - string
        - 'null'
        format: date-time
  example:
    interval:
    - '2019-05-21T19:36:44Z'
    - '2019-06-12T20:32:21Z'
properties:
  title: Common properties
  type: object
stacCatalogue:
  title: STAC Catalog Specification
  description:
    This object represents Catalogs in a SpatioTemporal Asset Catalog.
    This schema is deeply inspired on
    https://raw.githubusercontent.com/radiantearth/stac-spec/master/catalog-spec/json-schema/catalog.json
  Changes
  The link definition has been replaced by the one in OGC API Common.
  type: object
  required:
  - stac_version
  - id
  - description
  - links
properties:
  stac_version:
    title: STAC version
    type: string
    const: 0.8.0
    example: 0.8.0
  stac_extensions:
    title: STAC extensions
    type: array
    uniqueItems: true
    items:
      type: string
  id:
    title: Identifier
type: string
example: Daraa_mosaic_2019
title:
title: Title
type: string
example: Imagery from Daraa 2019
description:
title: Description
type: string
example: Catalog of imagery in coverage Daraa_mosaic_2019
links:
title: Links
type: array
items:
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
  common/1.0.0#/components/schemas/link'
example:
- rel: self
  href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-
  stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images
- rel: root
  href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-
  stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images
- rel: item
  href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-
  stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images/23
- rel: item
  href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-
  stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images/5
summaries:
  $ref: '#/components/schemas/stacSummaries'
stacSummaries:
type: object
additionalProperties:
oneOf:
- title: Stats
  type: object
  required:
  - min
  - max
  properties:
  min:
    title: Minimum value
    type:
    - number
    - string
  max:
    title: Maximum value
    type:
    - number
    - string
- title: Set of values
  type: array
  minItems: 1
  items:
    description: Any data type could occur.

stacProviders:
  type: array
  items:
    properties:
      name:
        title: Organization name
        type: string
        example: NGA
      description:
        title: Provider description
        type: string
        example: National Geospatial-Intelligence Agency
      roles:
        title: Organization roles
        type: array
        items:
          type: string
          enum:
          - producer
          - licensor
          - processor
          - host
      url:
        title: Homepage
        type: string
        format: url
        example: https://www.nga.mil

B.2. STAC item schema extended for images

For the purpose of facilitating the elaboration of an OpenAPI document, the OpenAPI 3.0 version of the schema to validate the response should also be included as part of the OpenAPI document. The original schema can be found in https://github.com/radiantearth/stac-spec/tree/master/item-spec. The STAC item schema adapted to the OpenAPI 3.0 schema is provided below in the object stacItem. This scheme also includes a stacItemImage object that extends the stacItem schema with specific elements defined in this OGC API Images draft specification.

stacItemImage:
  description: OGC API Image extension for STAC Item Adding some properties specific for imagery. (The proposed element `citation` has not been included because there is a properties/providers that can do the job partially)
  allOf:
  - $ref: '#/components/schemas/stacItem'
  - type: object
properties:
  geometry:
    type: object
    properties:
      type:
        example: Polygon
      coordinates:
        type: array
        items:
          type:
            - number
            - array
        example:
          - - 35.99601746
            - 32.57551892
          - - 36.08110064
            - 32.57551892
          - - 36.08110064
            - 32.64790382
          - - 35.99601746
            - 32.64790382
          - - 35.99601746
            - 32.57551892
      bbox:
        type: array
        items:
          type: number
        example:
          - 35.99601745605469
          - 32.57551891751058
          - 36.08110063620433
          - 32.64790382025549
  properties:
    type: object
    properties:
      nativeBbox:
        description: Native bounding box of the image.
        type: object
        required: bbox
        properties:
          bbox:
            description: One bounding boxes that describe the spatial extent of the dataset.
            type: array
            minItems: 4
            maxItems: 4
            items:
type: number
description: Coordinate reference system of the coordinates in the `bbox`. The default reference system is WGS 84 longitude/latitude.
type: string
default: 'http://www.opengis.net/def/crs/OGC/1.3/CRS84'
example: 'http://www.opengis.net/def/crs/EPSG/0/3857'

nominalResM:
description: Nominal resolution (in meters) of the image

type: number
format: double
example: 0.5332085767116562

cloudCover:
description: Percentage of cloud cover
type: number
format: double
example: 80.5

stacItem:
title: STAC Item
description: This object represents the metadata for an item in a SpatioTemporal Asset Catalog. This schema is deeply inspired on https://github.com/radiantearth/stac-spec/blob/master/item-spec/item-spec.md Changes The link definition has been replaced by the one in OGC API Common. The https://geojson.org/schema/Feature.json has been replaced by the GeoJSON geometry description in OGC API features.
type: object
allOf:
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-features/1.0.0#/components/schemas/featureGeoJSON'
  - type: object
    required:
    - stac_version
    - id
    - geometry
    - links
    - assets
    - bbox
    - properties
    properties:
      stac_version:
title: STAC version
type: string
const: 0.8.0
example: 0.8.0
stac_extensions:
  title: STAC extensions
  type: array
  uniqueItems: true
  items:
    anyOf:
      - title: Reference to a JSON Schema
        type: string
        format: uri
      - title: Reference to a core extension
        type: string
        enum:
          - checksum
          - cube
          - datetime-range
          - eo
          - label
          - pointcloud
          - sar
          - scientific
id:
  title: Provider ID
  description: Provider item ID
  type: string
  example: LC81530252014153LGN00
links:
  title: Item links
  description: Links to item relations
  type: array
  items:
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
example:
  - rel: self
    href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00.json"
  - rel: alternate
    href: "https://landsatonaws.com/L8/153/025/LC81530252014153LGN00"
    type: text/html
  - rel: root
    href: "http://landsat-pds.s3.amazonaws.com/L8/L1T-collection.json"
assets:
  title: Asset links
  description: Links to assets
  type: object
  # Next code has been commented to prevent a Error in the Swagger HUB
  # patternProperties:
  #   ":+":
  #   $ref: '#/components/schemas/stacAsset'
additionalProperties: false

element:
  example:
    thumbnail:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_thumb_large.jpg"
      type: image/jpeg
    metadata:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_MTL.txt"
      type: mtl
    B1:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B1.TIF"
      type: image/vnd.stac.geotiff
      eo: bands:
        - 0
    B2:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B2.TIF"
      type: image/vnd.stac.geotiff
      eo: bands:
        - 1
    B3:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B3.TIF"
      type: image/vnd.stac.geotiff
      eo: bands:
        - 2
    B4:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B4.TIF"
      type: image/vnd.stac.geotiff
      eo: bands:
        - 3
    B5:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B5.TIF"
      type: image/vnd.stac.geotiff
      eo: bands:
        - 4
    B6:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B6.TIF"
      type: image/vnd.stac.geotiff
      eo: bands:
        - 5
    B7:
      href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B7.TIF"
      type: image/vnd.stac.geotiff
eo:bands:
  - 6
B8:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B8.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
  - 7
B9:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B9.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
  - 8
B10:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B10.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
  - 9
B11:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B11.TIF"
  type: image/vnd.stac.geotiff
properties:
  type: object
  required:
  - datetime
properties:
  datetime:
    title: Date and Time
    description: 'The searchable date/time of the assets, in UTC (Formatted in RFC 3339)'
    type: string
    format: date-time
    example: '2019-05-21T19:36:44Z'
title:
  title: Item Title
  description: A human-readable title describing the item.
  type: string
  example: One image
license:
  title: Item Licenses
  type: string
  example: proprietary
providers:
  $ref: '#/components/schemas/stacProviders'
created:
This schema is dependent on the schema definition of featureGeoJSON that is included in the OGC API - Features Part 1: Core standard.
Appendix C: OpenAPI Domain

C.1. OpenAPI Domain images

This is the OGC API - Images domain OpenAPI developed and used in Testbed-15. This might be used and continued in a SWG in the future. This is based on and extracted from OpenAPI examples from the OGC API - Features - Part 1: Core standard (OGC 17-069r3).

This corresponds to a URL .../ogc-api-images/1.0.0

```json
openapi: 3.0.2

info:
  description: STAC Domain
  version: '1.0.0'
  title: STAC Domain

components:
schemas:
stacItemImage:
  description: OGC API Image extension for STAC Item Adding some properties specific for imagery. (The proposed element 'citation' has not been included because there is a properties/providers that can do the job partially)
allOf:
- $ref: '#/components/schemas/stacItem'
- type: object
  properties:
    geometry:
      type: object
      properties:
        type:
          example: Polygon
        coordinates:
          type: array
          items:
            type:
              number
              array
            example:
              - 35.99601746
              - 32.57551892
              - 36.08110064
              - 32.57551892
              - 36.08110064
              - 32.64790382
              - 35.99601746
              - 32.64790382
              - 35.99601746
              - 32.57551892
```
bbox:
  type: array
  items:
    type: number
  example:
    - 35.99601745605469
    - 32.5751891751058
    - 36.08110063620433
    - 32.64790382025549
properties:
  type: object
  properties:
    nativeBbox:
      description: Native bounding box of the image.
      type: object
      required: bbox
      properties:
        bbox:
          description: One bounding boxes that describe the spatial extent of the dataset.
          type: array
          minItems: 4
          maxItems: 4
          items:
            type: number
            example:
              - 780349.63
              - 6556104.14
              - 803726.72
              - 6582470.15
        crs:
          description: Coordinate reference system of the coordinates in the `bbox`.
          type: string
          default: http://www.opengis.net/def/crs/OGC/1.3/CRS84
          example: http://www.opengis.net/def/crs/EPSG/0/3857
    nominalResM:
      description: Nominal resolution (in meters) of the image
      type: number
      format: double
      example: 0.5332085767116562
    cloudCover:
      description: Percentage of cloud cover
      type: number
      format: double
      example: 80.5
STAC Item

title: STAC Item
description:
This object represents the metadata for an item in a SpatioTemporal Asset Catalog.

This schema is deeply inspired on https://github.com/radiantearth/stac-spec/blob/master/item-spec/item-spec.md

Changes
The link definition has been replaced by the one in OGC API Common.
The https://geojson.org/schema/Feature.json has been replaced by the GeoJSON geometry description in OGC API features.

type: object

allOf:
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-features/1.0.0#/components/schemas/featureGeoJSON'
- type: object
  required:
  - stac_version
  - id
  - geometry
  - links
  - assets
  - bbox
  - properties

properties:
  stac_version:
    title: STAC version
    type: string
    const: 0.8.0
    example: 0.8.0
  stac_extensions:
    title: STAC extensions
    type: array
    uniqueItems: true
    items:
      anyOf:
        - title: Reference to a JSON Schema
          type: string
          format: uri
        - title: Reference to a core extension
          type: string
          enum:
            - checksum
            - cube
            - datetime-range
            - eo
            - label
            - pointcloud
            - sar
            - scientific

id:
title: Provider ID
description: Provider item ID
type: string
eexample: LC81530252014153LGN00

links:
title: Item links
description: Links to item relations
type: array
items:
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
eexample:
  - rel: self
    href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00.json"
  - rel: alternate
    href: "https://landsat.onaws.com/L8/153/025/LC81530252014153LGN00"
    type: text/html
  - rel: root
    href: "http://landsat-pds.s3.amazonaws.com/L8/L1T-collection.json"

assets:
title: Asset links
description: Links to assets
type: object
# Next code has been commented to prevent an Error in the Swagger HUB
# patternProperties:
#  ".+":
#    $ref: '#/components/schemas/stacAsset'
additionalProperties: false
eexample:
  thumbnail:
    href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_thumb_large.jpg"
    type: image/jpeg
  metadata:
    href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_MTL.txt"
    type: mtl
  B1:
    href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B1.TIF"
    type: image/vnd.stac.geotiff
eo:bands:
  - 0
  B2:
    href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B2.TIF"
    type: image/vnd.stac.geotiff
eo:bands:
  - 1
B3:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B3.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 2
B4:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B4.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 3
B5:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B5.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 4
B6:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B6.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 5
B7:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B7.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 6
B8:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B8.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 7
B9:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B9.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 8
B10:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B10.TIF"
  type: image/vnd.stac.geotiff
eo:bands:
    - 9
B11:
  href: "http://landsat-pds.s3.amazonaws.com/L8/153/025/LC81530252014153LGN00/LC81530252014153LGN00_B11.TIF"
type: image/vnd.stac.geotiff
eo:bands:
  - 10
properties:
type: object
required:
  - datetime
properties:
datetime:
title: Date and Time
description: 'The searchable date/time of the assets, in UTC (Formatted in RFC 3339)'
type: string
format: date-time
example: '2019-05-21T19:36:44Z'
title:
title: Item Title
description: A human-readable title describing the item.
type: string
example: One image
license:
title: Item Licenses
type: string
example: proprietary
providers:
  $ref: '#/components/schemas/stacProviders'
created:
title: Metadata updated at
type: string
format: date-time
example: '2019-06-21T19:36:44Z'
updated:
title: Metadata updated at
type: string
format: date-time
example: '2019-08-21T19:36:44Z'
collection:
title: Collection ID
description: The ID of the STAC Collection this Item references to.
type: string
example: Landsat8
stacCollection:
title: STAC Collection Specification
description:
This object represents Collections in a SpatioTemporal Asset Catalog. Stac Collection is described in https://github.com/radiantearth/stac-spec/blob/master/collection-spec/collection-spec.md
This schema is a replica of https://raw.githubusercontent.com/radiantearth/stac-spec/master/collection-spec/json-schema/collection.json
type: object
allOf:
  - $ref: '#/components/schemas/stacCatalogue'
  - title: STAC Collection
description: These are the fields specific to a STAC Collection. All other fields are inherited from STAC Catalog.
type: object
required:
  - license
  - extent
properties:
  stac_extensions:
    title: STAC extensions
type: array
uniqueItems: true
items:
  anyOf:
    - title: Reference to a JSON Schema
type: string
format: uri
    - title: Reference to a core extension
type: string
enum:
  - asset
  - checksum
  - scientific
example: []
keywords:
  title: Keywords
type: array
items:
  type: string
example: Daraa
version:
  title: Collection Version
type: string
example: 1.0.0
license:
  title: Collection License Name
type: string
example: proprietary
providers:
  $ref: '#/components/schemas/stacProviders'
extent:
  title: Extents
type: object
required:
  - spatial
  - temporal
properties:
spatial:
  title: Spatial extent object
  type: object
  required:
  - bbox
  properties:
    bbox:
      title: Spatial extents
      type: array
      minItems: 1
      items:
        title: Spatial extent
        type: array
        minItems: 4
        maxItems: 6
        items:
          type: number
          example:
            bbox:
              - 35.99601745605469
              - 32.50426061084722
              - 36.08110063620433
              - 32.72028872300039

temporal:
  title: Temporal extent object
  type: object
  required:
  - interval
  properties:
    interval:
      title: Temporal extents
      type: array
      minItems: 1
      items:
        title: Temporal extent
        type: array
        minItems: 2
        maxItems: 2
        items:
          type:
            - string
            - 'null'
          format: date-time
          example:
            interval:
              - '2019-05-21T19:36:44Z'
              - '2019-06-12T20:32:21Z'

properties:
  title: Common properties
  type: object
This object represents Catalogs in a SpatioTemporal Asset Catalog. This schema is deeply inspired on https://raw.githubusercontent.com/radiantearth/stac-spec/master/catalog-spec/json-schema/catalog.json

Changes
The link definition has been replaced by the one in OGC API Common.

type: object
required:
- stac_version
- id
- description
- links
properties:
stac_version:
  title: STAC version
  type: string
  const: 0.8.0
  example: 0.8.0
stac_extensions:
  title: STAC extensions
  type: array
  uniqueItems: true
  items:
    type: string
id:
  title: Identifier
  type: string
  example: Daraa_mosaic_2019
title:
  title: Title
  type: string
  example: Imagery from Daraa 2019
description:
  title: Description
  type: string
  example: Catalog of imagery in coverage Daraa_mosaic_2019
links:
  title: Links
  type: array
  items:
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
    example:
      - rel: self
        href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images
      - rel: root
        href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images
- rel: item
  href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images/23
- rel: item
  href: https://tb15.cubewerx.com/cubewerx/cubeserv/op-
stac/wmts/1.0.0/collections/Daraa_mosaic_2019/images/5
summaries:
  $ref: '#/components/schemas/stacSummaries'
stacSummaries:
  type: object
  additionalProperties:
    oneOf:
    - title: Stats
      type: object
      required:
      - min
      - max
      properties:
        min:
          title: Minimum value
          type:
          - number
          - string
        max:
          title: Maximum value
          type:
          - number
          - string
    - title: Set of values
      type: array
      minItems: 1
      items:
        description: Any data type could occur.
stacAsset:
  type: object
  required:
  - href
  properties:
    href:
      title: Asset reference
      type: string
title:
      title: Asset title
      type: string
    type:
      title: Asset type
      type: string
stacProviders:
  type: array
  items:
    properties:
C.2. OpenAPI Domain changset

This is the OGC API - Changeset domain OpenAPI developed and used in Testbed-15. This might be used and continued in a SWG in the future.

This corresponds to a URL .../ogc-api-changeset/1.0.0

```json
name:
  title: Organization name
  type: string
  example: NGA
description:
  title: Provider description
  type: string
  example: National Geospatial-Intelligence Agency
roles:
  title: Organization roles
  type: array
  items:
    type: string
    enum:
      - producer
      - licensor
      - processor
      - host
url:
  title: Homepage
  type: string
  format: url
  example: https://www.nga.mil
parameters:
  imageId:
    name: imageId
    in: path
    description: local identifier of a image
    required: true
    schema:
      type: string
```

openapi: 3.0.2
# Revisions:
# 2019-08-02 initial version

info:
  title: OGC API Checkpoint
  description: 'A delta update is the subset of resources that have changed between two checkpoints and as such is itself a subset of resources from the specified collection.'
  Extracted from: https://portal.opengeospatial.org/wiki/Testbed15/DeltaUpdateApi'
version: '1.0.0'

components:
  parameters:
    checkPoint:
      name: checkPoint
      in: path
      description: Last checkpoint the client has retrieved data. Without it, the response to accessing the delta update path would be all changes since auditing began.
      required: false
      schema:
        type: string
    checkPoint-query:
      name: checkPoint
      in: query
      description: Last checkpoint the client has retrieved data. Without it, the response to accessing the delta update path would be all changes since auditing began.
      required: false
      schema:
        type: string
    changeSetType:
      name: changeSetType
      in: query
      description: |
        'When successul, the service will respond to a query in one of two ways. It may either generate a complete response document containing resources that satisfy the operation or it may simply generate an empty response container that indicates the count of the total number of resources that the operation would return. Which of these two responses is generated is determined by the value of the optional changeSetType parameter.

        The allowed values for this parameter are 'full', 'summary' and 'package'. If the value of the 'changeSetType' parameter is set to 'full' causes the server to return the complete changeSet file following the 'changeSet' schema. Use this value to retrieve new features in the OGC API features as part of the change set file.

        If the value of the 'changeSetType' parameter is set to 'summary' causes the server to return a summary of the changes. The summary follows the 'changeSetSummary' schema.

        If the value of the 'changeSetType' parameter is set to 'package' causes the server to return a package (e.g. a ZIP file) that will include a summary of the changes (The summary follows the 'changeSetSummary' schema) and the changes themselves as separated parts in the package. Use this value for requesting changes in tiled resources.

        The default value is 'full'.

        NOTE in the original Peter Vretanos design this parameter was called 'resultType' but it has been changed here to avoid conflicts with https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/resultType'
      required: false
      style: form
explode: false

schema:
  type: string
default: full
enum:
  - summary
  - full
  - package
example: full

priority:
  name: priority
  in: query
  description: |
    One or more priority labels used to filter a delta update response.
    
The allowed values for this parameter are 'low', 'medium', 'high' and 'all'
The default value is 'all' for retrieve all changes.
required: false
style: form
explode: false

schema:
  type: string
default: all
enum:
  - low
  - medium
  - high
  - all
example: high

schemas:
  changeSetSummary:
    title: changeSetSummary
    description: A document containing a summary of the updates since a specified checkpoint
    type: object
    required:
    - summaryOfChangedItems
    properties:
      summaryOfChangedItems:
        description: a per-priority list of change counts
        type: array
        items:
          description: a count of changes corresponding to a specific priority
label
  type: object
  required:
  - priority
  - count
  properties:
    priority:
description: the priority label
type: string
count:
  description: the count of changes tagged with the corresponding priority
label
type: integer
element:
  priority: high
count: 2
  priority: medium
count: 4
  priority: low
count: 67

changeSet:
title: changeSet
description: A document containing the updates since a specified checkpoint
allOf:
  - $ref: '#/components/schemas/changeSetSummary'
  - type: object
    properties:
      checkPoint:
        description: the checkpoint value from which new changes are requested.
        type: string
        example: "cp143756"

extentOfChangedItems:
  description: extents of the new, changed or deleted items
  type: array
  items:
    description: extent of the new, changed or deleted items
    type: object
    required:
      bbox
    properties:
      bbox:
        type: array
      items:
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/bbox'

crs:
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/crs'

numberOfReturnedItems:
  description: the number of changed items that are presented in the response; this may be less than the total number of changes
  type: integer
  example: 6

changedItems:
  description: a list of new or modified resources. Useful for features.
  Not recommended for tiles
  type: array
items:
  description: a representations of or reference to the changed resource; e.g.
  a GeoJSON-encoded feature

  type: object
  required:
  - items

  properties:
  priority:
    description: a priority label
    type: string
  items:
    type: array
    items:
      oneOf:
        - type: object
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'

  example:
    - priority: high
      items: []
    - priority: medium
      items: []

deletedItems:
  description: a list of identifiers of deleted resources. Useful for features. Not recommended for tiles.
  type: array
  items:
    description: the identifier of a deleted feature
    type: object
    required:
    - items

    properties:
    priority:
      description: a priority label
      type: string
    items:
      type: array
      items:
        type: string

    example:
    - priority: medium
      items:
        - "/collections/BUILDINGS/items/F4674"
        - "/collections/BUILDINGS/items/F37465819"

changeSetTiles:
  title: changeSetTiles
  description: A document containing the tiles updated since a specified checkpoint
  allOf:
    - $ref: '#/components/schemas/changeSet'
- type: object
  properties:
    scalesOfChangedItems:
      type: object
      description: Range of scales affected by the changes. If not present, all scales are affected
      required:
        - minScaleDenominator:
        - maxScaleDenominator:
      properties:
        minScaleDenominator:
          type: number
          format: double
          example: 10000
        maxScaleDenominator:
          type: number
          format: double
          example: 1000000
Appendix D: OpenAPI Examples

D.1. OpenAPI Images example

In this example we present an imaginary API server that provides access to images using the OGC API - Images draft specification.

```yaml
openapi: 3.0.1

servers:
  # Added by API Auto Mocking Plugin
  - description: SwaggerHub API Auto Mocking
    url: https://virtserver.swaggerhub.com/UAB-CREAF/ogc-api-images-opf-xml/1.0.0
  - description: Server
    url: http://data.example.org

info:
  version: '1.0.0'
  title: 'Open Portrayal Framework Image API'
  description: 'This is a draft of the OGC Testbed-15 Image API in the Open Portrayal Framework task. The Image API is a Web API for fetching and managing a server that maintains products composed by lists of images. The tipical example is a remote sensing product exposed a single mosaic but internally composed by many scenes that are constantly received from the satellite.'

contact:
  name: Joan Masó
  email: joan.maso@uab.cat

license:
  name: OGC License
  url: 'https://raw.githubusercontent.com/opengeospatial/WFS_FES/master/LICENSE'

tags:
  - name: OGC API Common
    description: |-Common characteristics of this API
  - name: Images
    description: |-access to Images
  - name: Manage Images
    description: |-Creation, modification of deletion of images

paths:
  '/':
    get:
      tags:
        - OGC API Common
      summary: landing page
      description: |-The landing page provides links to the API definition, the conformance statements and to the feature collections in this dataset.
```
operationId: getLandingPage
parameters:
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-json-html'
responses:
  '200':
    description: |
      Links to the API capabilities shared by this API.
    content:
      application/json:
        schema:
          $ref: '#/components/schemas/landingPage'
      text/html:
        schema:
          type: string
  '500':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
'/conformance':
  get:
    summary: information about specifications that this API conforms to
    description: |
      A list of all requirements classes specified in a standard that the server conforms to.
    operationId: getConformanceDeclaration
    parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-json'
    tags:
      - OGC API Common
    responses:
      '200':
        description: |
          the URIs of all requirements classes supported by this API
        content:
          application/json:
            schema:
              $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/confClasses'
            example:
              - 'http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core'
              - 'http://www.opengis.net/spec/ogcapi-common-1/1.0/req/collections'
              - 'http://www.opengis.net/spec/ogcapi-images-1/1.0/req/core'
              - 'http://www.opengis.net/spec/ogcapi-images-1/1.0/req/transactional'
      '400':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/InvalidParam'
      '406':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotAcceptable'
common/1.0.0#/components/responses/UnsupportedFormat'

'500':
   $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/responses/ServerError'
'/collections':
   get:
      tags:
      - OGC API Common
      summary: the collections in the dataset
      operationId: getCollections
      parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/parameters/f-json-html'
      responses:
        '200':
           $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/responses/Collections'
        '500':
           $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/responses/ServerError'
'/collections/{collectionId}':
   get:
      tags:
      - OGC API Common
      summary: describe a collection
      operationId: describeCollection
      parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/parameters/collectionId'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/parameters/f-json-html'
      responses:
        '200':
           description: Metadata about the collection including image list
           content:
              application/json:
                 schema:
                    $ref: '#/components/schemas/collection'
              text/html:
                 schema:
                    type: string
        '404':
           $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/responses/NotFound'
        '500':
           $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
common/1.0.0#/components/responses/ServerError'
'/collections/{collectionId}/images':
   get:
      tags:
Images

**Summary:** retrieve images of the collection

**Operation ID:** getImages

**Parameters:**
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/limit'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/offset'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/bbox'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/datetime'
- $ref: '#/components/parameters/f-stac-html'

**Responses:**

- **200**:
  - **Description:** Information about the feature collection plus the first features matching the selection parameters.
  - **Content:**
    - **application/stac+json**:
      - **Schema**: $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/schemas/stacCollection'
    - **text/html**:
      - **Schema**:
        - **Type**: string

- **404**:
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'

- **500**:
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'

**Options**:

- **Tags**: Manage images

**Summary:** |- Options for creating new images

**Operation ID:** testSupportManageImages

**Description:** |- Determines if POST is supported by this resource and user. See Accept headers for that.

**Parameters:**
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'

**Security:**
- BasicAuth: []

**Responses:**

- **204**:
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/limit'
post:
  tags:
    - Manage images
  summary: |
    adds a new image
  operationId: addImage
  description: |
    Adds an image to the image collection
    The URI of the new image is returned in the header `Location`.
    This operation is only available to registered image authors.
  security:
    - BasicAuth: []
  parameters:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
  responses:
    '201':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/Created'
    '400':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/Invalid'
    '401':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/UnauthorizedAccess'
  requestBody:
    description: |
      image to be added in the form of a STAC document
    content:
      image/geo+tiff:
        schema:
          type: string
          format: binary
          application/vnd.ogc.multipart;container=application/x-zip-compressed;images=geo+tiff:
            schema:
              type: string
              format: binary
              application/vnd.ogc.multipart;container=application/x-zip-compressed;images=geo+tiff;description=application/stac+json:
                schema:
                  type: string
                  format: binary
'/collections/{collectionId}/images/{imageId}':
get:
  tags:
    - Images
summary: fetch an image
operationId: getImage
parameters:
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/parameters/imageId'
  - $ref: '#/components/parameters/f-stac-html'
responses:
  '200':
    description: |
      An image.
    content:
      application/stac+json:
        schema:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/schemas/stacItemImage'
      text/html:
        schema:
          type: string
  '404':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'
  '500':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
options:
  tags:
    - Manage images
  summary: |
    Options for modifying or deleting an image.
  operationId: testSupportManageImage
  description: |
    Determines if PUTS or DELETE is supported by this resource and user. See Allow headers for that.
  parameters:
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
  - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/parameters/imageId'
  security:
    - BasicAuth: []
  responses:
    '204':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NoContent'
    '401':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/UnauthorizedAccess'
put:
  tags:
- Manage images

**summary:**

  replace an image resource or add a new one

**description:**

Replace an existing image with the id `imageId`. If no such image exists, a new resource with that id is added.

The resource will only be available in the native format in which the resource is posted. There is no support for automated conversions to other representations.

This operation is only available to registered image authors.

**operationId:** updateImage

**security:**

- BasicAuth: []

**parameters:**

- `$ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'

- `$ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/parameters/imageId'

**requestBody:**

**description:**

A single image resource.

**content:**

application/stac+json:

  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/schemas/stacItem'

image/geo+tiff:

  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/schemas/stacItem'

  type: string

  format: binary

application/vnd.ogc.multipart;container=application/x-zip-compressed;images=geo+tiff:

  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/schemas/stacItem'

  type: string

  format: binary

application/vnd.ogc.multipart;container=application/x-zip-compressed;images=geo+tiff;description=application/stac+json:

  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/schemas/stacItem'

  type: string

  format: binary

**responses:**

`204`:

$ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/Updated'

`401`:

$ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/UnauthorizedAccess'

**delete:**

**tags:**

- Manage images
summary: delete an image resource

description: Delete an existing image with the id `imageId`. If no such resource exists, an error is returned. This operation is only available to registered image authors.

operationId: deleteImage

security:
- BasicAuth: []

parameters:
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-images/1.0.0#/components/parameters/imageId'

responses:
'204':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/Deleted'
'401':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/UnauthorizedAccess'
'404':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'

components:

schemas:
  landingPage:
    allOf:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/landingPage'
    - $ref: '#/components/schemas/landingPage-link'

  landingPage-link:
    #This element is a duplicate of the one in OGC API common but it is enriched with more examples for maps and other resource types.
    type: object
    required:
    - links
    properties:
      links:
        type: array
        items:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
      example:
        - href: 'http://data.example.org/?f=json'
          rel: self
          type: application/json
          title: this document
        - href: 'http://data.example.org/?f=html'
          rel: alternate
type: text/html
title: this document in HTML
  - href: 'http://data.example.org/api?f=json'
    rel: service
type: application/vnd.oai.openapi+json;version=3.0
title: the API definition in OpenAPI 3.0 JSON
  - href: 'http://data.example.org/api?f=html'
    rel: service
type: text/html
title: the API definition in HTML
  - href: 'http://data.example.org/conformance?f=json'
    rel: conformance
type: application/json
title: the list of conformance classes implemented by this API
  - href: 'http://data.example.org/collections?f=json'
    rel: data
type: application/json
title: The feature collections in the dataset in JSON
  - href: 'http://data.example.org/collections?f=html'
    rel: data
type: text/html
title: The feature collections in the dataset in HTML
  - href: 'http://data.example.org/tileMatrixSet?f=json'
    rel: tileMatrixSets
type: application/json
title: the list of tileMatrixSets implemented by this API in JSON
  - href: 'http://data.example.org/tileMatrixSet?f=html'
    rel: tileMatrixSets
type: text/html
title: the list of tileMatrixSets implemented by this API in HTML

collection:
  allOf:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/collection'
    - $ref: '#/components/schemas/collection-link'
collection-link:
  #This element is a duplicate of the one in OGC API common but it is enriched with more examples for maps and other resource types.
  type: object
  required:?
    - links
  properties:
    links:
      type: array
      items:
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
      example:
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-collection-describedBy'
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-collection-describedBy'
D.2. OpenAPI Images example

In this example we present an imaginary API server that provides access to tiles with changeset support using the OGC API - Changeset draft specification.

```yaml
openapi: 3.0.0
# Revisions:
# 2019-07-14 Reparated from a more complex example

servers:
  # Added by API Auto Mocking Plugin
  - description: SwaggerHub API Auto Mocking
    url: https://virtserver.swaggerhub.com/UAB-CREAF/ogc-api-tiles-opf-xmp-changeset/1.0.0
  - description: SwaggerHub API Auto Mocking
    url: https://virtserver.swaggerhub.com/UAB-CREAF/ogc-api-tiles-opf-xmp-changeset/1.0.0
  - description: SwaggerHub API Auto Mocking
    url: https://virtserver.swaggerhub.com/UAB-CREAF/ogc-api-map-tiles-opf-xmp-mt-more-1-collection/1.0.0
  - description: SwaggerHub API Auto Mocking
    url: https://virtserver.swaggerhub.com/joanma747/opf-map-tiles-api/1.0.0

info:
  title: 'Open Portrayal Framework ChangeSet API'
```
This is a draft of an example of a service following the OGC API changeset for tiled maps and features. It is elaborated in the Testbed-15 Open Portrayal Framework in collaboration with the WMS.SWG. The Map Tile API is a Web API for fetching and managing maps and tiles.

```
description: |-  
  This is a draft of an example of a service following the OGC API changeset for tiled maps and features  

  It is elaborated in the Testbed-15 Open Portrayal Framework in collaboration with the WMS.SWG. The Map Tile API is a Web API for fetching and managing maps and tiles.

content:

version: "1.0.0"
contact:
  name: Joan Maso
  email: joan.maso@uab.cat
license:
  name: OGC License
tags:
  - name: OGC API Common
    description: |
      Common characteristics of this API
  - name: Map tiles metadata
    description: |
      Metadata about map tiles and tileMatrixSets
  - name: MultiTiles
    description: |
      MultiTiles with changeset
  - name: Features
    description: |
      Features with changeset
paths:
  
get:
  tags:
    - OGC API Common
  summary: landing page
  description: |
    The landing page provides links to the API definition, the conformance statements and to the feature collections in this dataset.
  operationId: getLandingPage
  parameters:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-json-html'
  responses:
    '200':
      description: |
        Links to the API capabilities and the TileMatrixSets shared by this API.
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/landingPage'
```

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text/html:
  schema:
    type: string
  '500':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
    common/1.0.0#/components/responses/ServerError'
  '/conformance':
    get:
      description: |
        A list of all requirements classes specified in a standard that the
        server conforms to.
      operationId: getConformanceDeclaration
      parameters:
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
          common/1.0.0#/components/parameters/f-json'
      tags:
        - OGC API Common
      responses:
        '200':
          description: |
            the URIs of all requirements classes supported by this API
          content:
            application/json:
              schema:
                $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-
                common/1.0.0#/components/schemas/confClasses'
              example:
                conformsTo:
                # OGC API Common core consists on the landingPage, conformance
                - 'http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core'
                # OGC API Common collections consists adds the capability to have
                collections
                - 'http://www.opengis.net/spec/ogcapi-common-
                  1/1.0/req/collections'
                # We need to be sure which ones are still valid when adopting
                OpenAPI.
                - 'http://www.opengis.net/spec/ogcapi-features-1/1.0/req/core'
                - 'http://www.opengis.net/spec/ogcapi-features-1/1.0/req/oas30'
                - 'http://www.opengis.net/spec/ogcapi-features-1/1.0/req/html'
                - 'http://www.opengis.net/spec/ogcapi-features-1/1.0/req/geojson'
                - 'http://www.opengis.net/spec/ogcapi-maps-1/1.0/req/core'
                - 'http://www.opengis.net/spec/ogcapi-maps-1/1.0/req/styles'
                - 'http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/core'
                - 'http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/tmxs'
                - 'http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/collections'
                - 'http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/multitiles'
                - 'http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/cols-
                  multitiles'
                - 'http://www.opengis.net/spec/ogcapi-changeset-1/1.0/req/core'
                - 'http://www.opengis.net/spec/ogcapi-changeset-
                  1/1.0/req/features'
'400':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/InvalidParam'
'406':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/UnsupportedFormat'
'500':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
'/collections':
  get:
    tags:
      - OGC API Common
    summary: the collections in the dataset
    operationId: getCollections
    parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-json-html'
    responses:
      '200':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/Collections'
      '500':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
'/collections/{collectionId}':
  get:
    tags:
      - OGC API Common
    summary: describe a collection
    operationId: describeCollection
    parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-json-html'
    responses:
      '200':
        description: Metadata about the collection including style information.
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/collection'
          text/html:
            schema:
              type: string
      '404':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'
'/tileMatrixSets':
  get:
    tags:
      - Map tiles metadata
    summary: fetch all available tile matrix sets (tiling schemes)
    operationId: getTileMatrixSets
    parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/parameters/f-json'
    responses:
      '200':
        description: An array of tile matrix sets (tiling schemes).
        content:
          application/json:
            schema:
              $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/schemas/tileMatrixSets'
      '500':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
'/tileMatrixSets/{tileMatrixSetId}':
  get:
    tags:
      - Map tiles metadata
    summary: fetch a tile matrix sets (tiling scheme) by id
    operationId: getTileMatrixSetDescription
    parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/parameters/tileMatrixSetId'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-json'
    responses:
      '200':
        description: tile matrix sets (a tiling scheme).
        content:
          application/json:
            schema:
              $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/schemas/tileMatrixSet'
      '404':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'
      '500':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
'/collections/{collectionId}/items':
  get:
tags:
- OGC API Features

summary: retrieve features of the feature collection

description: |

IMPORTANT: This operation is defined by in OGC API features. It is included here for INFORMATION ONLY But is OUT OF SCOPE for Maps and Tiles.

operationId: getFeatures

parameters:
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/limit'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/offset'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/bbox'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/datetime'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/resultType'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/checkPoint-query'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/priority'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-features/1.0.0#/components/parameters/properties'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-json-html'

  - name: f_code
    in: query
    description: Filter the collection by f_code
    required: false
    style: form
    explode: false
    schema:
      type: string

responses:
'200':
  description: |
  Information about the feature collection plus the first features matching the selection parameters.
  content:
  application/geo+json:
    schema:
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-features/1.0.0#/components/schemas/featureCollectionGeoJSON'
  application/changeset+json:
    schema:
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/schemas/changeSet'
  text/html:
schema:
  type: string

'304':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotModified'

'404':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'

'500':
  $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'

'/collections/{collectionId}/map/tiles':
  get:
    tags:
    - Map tiles metadata
    summary: fetch a map tiles description
    description: |
      Retrieves the tiles description for this collection including the `links` to get a `tile`, the `TileMatrixSetLink` and the `infoTemplate`
    operationId: describeMapTiles
    parameters:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
    responses:
      '200':
        description: |
          Description of the map tiles.
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/map-tiles'
      '404':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'
      '500':
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'

'/map/tiles':
  get:
    tags:
    - Map tiles metadata
    summary: fetch a map tiles description
    description: |
      Retrieves the map tiles description for this collection including the `links` to get a `tile`
    operationId: describeMapTilesCollections
    responses:
      '200':
        description: |
          Links to the map tiles.
        content:
application/json:
  schema:
    type: object
    required:
    - links
    properties:
      links:
        type: array
        items:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
      example:
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-col-this'
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-col-tile'
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-col-info'
        - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-col-multitile'
  '404':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'
  '500':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
'/collections/{collectionId}/map/{styleId}/tiles/{tileMatrixSetId}':
  get:
    tags:
    - MultiTiles
    summary: |
      fetch tiles of a collection.
    operationId: getMapTilesCollectionId
    parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/collectionId'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-styles/1.0.0#/components/parameters/styleId'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-maps/1.0.0#/components/parameters/transparent'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-maps/1.0.0#/components/parameters/b bgcolor'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/parameters/tileMatrixSetId'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/parameters/scaleDenominator'
      - $ref: '#/components/parameters/bbox'
      - $ref: '#/components/parameters/f-tile'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/parameters/multiTileType'
responses:
  '200':
    description: |- A tiling scheme used to partition the collection into tiles.
    content:
      application/changset+xml:
        schema:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/schemas/changsetTiles'
      application/json:
        schema:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/schemas/changsetTiles'
      application/vnd.ogc.multipart;container=application/x-zip-compressed;tiles=image/png:
        schema:
          type: string
          format: binary
    '304':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotModified'
    '404':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'
    '500':
      $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'
'/map/tiles/{tileMatrixSetId}':
  get:
    tags:
      - MultiTiles
    summary: |- fetch tiles of multiple collections.
    operationId: getMapTilesCollections
    parameters:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/parameters/collections'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-styles/1.0.0#/components/parameters/styles'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-maps/1.0.0#/components/parameters/transparent'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-maps/1.0.0#/components/parameters/bgcolor'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/checkPoint-query'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/changeSetType'
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/priority'
      - $ref: '#/components/parameters/f-json-xml'
tiles/1.0.0#/components/parameters/tileMatrixSetId'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/parameters/scaleDenominator'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/bbox'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/parameters/f-tile'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/parameters/multiTileType'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/checkPoint-query'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/changeSetType'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/parameters/priority'
- $ref: '#/components/parameters/f-json-zip'

responses:
  '200':
    description: |-  
      A tiling scheme used to partition the collection into tiles.
    content:
      application/changeset+json:
        schema:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-changeset/1.0.0#/components/schemas/changeSetTiles'
      application/json:
        schema:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/schemas/tileSet'
      application/vnd.ogc.multipart;container=application/x-zip-compressed;tiles=image/png:
        schema:
          type: string
          format: binary
  '304':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotModified'
  '404':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/NotFound'
  '500':
    $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/responses/ServerError'

components:
  schemas:
    landingPage:
      allOf:
      - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/landingPage'
      - $ref: '#/components/schemas/landingPage-link'

 #This element is a duplicate of the one in OGC API common but it is enriched
with more examples for maps and other resource types.

```json
    type: object
    required:
      - links
    properties:
      links:
        type: array
        items:
          $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
        example:
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-landingPage-this'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-landingPage-alternate'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-landingPage-service-json'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-landingPage-service-html'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-landingPage-conformance'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-landingPage-collections-json'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-landingPage-collections-html'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/examples/link-landingPage-tms-json'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-landingPage-map-tiles'

collection:
  allOf:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/collection'
    - $ref: '#/components/schemas/collection-link'

collection-link:
  #This element is a duplicate of the one in OGC API common but it is enriched with more examples for maps and other resource types.
  type: object
  required:
    - links
  properties:
    links:
      type: array
      items:
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
        example:
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-collection-this'
          - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-collection-describedBy'
```
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-collection-license-html'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/examples/link-collection-license-rdf'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-features/1.0.0#/components/examples/link-collection-items'
- $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-collection-map-tiles'

map-tiles:
  allOf:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-tiles/1.0.0#/components/schemas/tiles'
    - $ref: '#/components/schemas/map-tiles-link'

map-tiles-link:
  #This element is a duplicate of the one in OGC API common but it is enriched with more examples for maps and other resource types.
  type: object
  required:
    - links
  properties:
    links:
      type: array
      items:
        $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-common/1.0.0#/components/schemas/link'
  example:
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-this'
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-tile'
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-info'
    - $ref: 'https://api.swaggerhub.com/domains/UAB-CREAF/ogc-api-map-tiles/1.0.0#/components/examples/link-map-tiles-multitile'

parameters:
  f-json-zip:
    name: f
    in: query
    description: The format of the response. If no value is provided, the standard http rules apply, i.e., the accept header is used to determine the format.
    required: false
    style: form
    explode: false
    schema:
      type: string
      enum:
        - json
- zip
  example: json
f-png-jpeg:
  name: f
  in: query
  description: |
  The format of the response. If no value is provided, the standard http rules apply, i.e., the accept header is used to determine the format.

  Pre-defined values jpeg, png or gif for image based tiles
  The response to other values is determined by the server.
  required: false
  style: form
  explode: false
  schema:
    type: string
    enum:
      - png
      - jpeg
      - gif
  example: png

f-tile:
  name: f-tile
  in: query
  description: |
  The format of the response. If no value is provided, the standard http rules apply, i.e., the accept header is used to determine the format.

  Pre-defined values are jpeg, png or gif for image based tiles
  The response to other values is determined by the server.
  required: false
  style: form
  explode: false
  schema:
    type: string
    enum:
      - image/png
      - image/jpeg
      - image/gif
  example: image/png
## Appendix E: Revision History

Table 2. Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Editor</th>
<th>Release</th>
<th>Primary clauses modified</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 28, 2019</td>
<td>J. Masó</td>
<td>-</td>
<td>all</td>
<td>initial version based on an implementation of Keith Pomakis</td>
</tr>
<tr>
<td>October 14, 2019</td>
<td>J. Masó</td>
<td>0.8</td>
<td>all</td>
<td>ready for OGC review</td>
</tr>
<tr>
<td>October 21, 2019</td>
<td>J. Masó</td>
<td>0.9</td>
<td>all</td>
<td>results of the OGC review</td>
</tr>
<tr>
<td>October 25, 2019</td>
<td>J. Masó</td>
<td>1.0</td>
<td>all</td>
<td>document ready for the 3 week rule in the Toulouse TC.</td>
</tr>
<tr>
<td>December 12, 2019</td>
<td>C. Reed</td>
<td>1.0</td>
<td>Various</td>
<td>Minor edits to Abstract, Exec Summary, and various other clauses prior to publication as a Public ER</td>
</tr>
<tr>
<td>January 3, 2020</td>
<td>G. Hobona</td>
<td>1.0</td>
<td>Various</td>
<td>Final OGC staff review and edits.</td>
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Appendix F: Bibliography
