CEOS STAC Best Practices

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1. Introduction

1.1 Purpose of document

The STAC ecosystem comprises both API-related and metadata-related specifications. This document provides server implementation Best Practices for STAC-based metadata publication and related discovery services allowing for standardized and harmonized access to metadata and data for CEOS agencies.

TBD.

1.2 Document overview

The document is organized as follows:

- Chapter 1 is the introduction of the document.
- Chapter 2 gives an overview of objectives and needs.
- Chapter 3 ...
- Chapter 4 ...

There are three different levels of obligation for the Best Practices presented in the current document:

- “Requirements” are mandatory and must be implemented,
- “Recommendations” are optional, but strongly recommended for interoperability,
- “Optional” indicates an additional good practice.

In addition, "Permissions" indicate allowed deviations from one of more of the underlying specifications in cases where a subset of the original requirements is deemed sufficient in the context of CEOS.

1.3 Terms, definitions and abbreviated terms

1.3.1 Terms and Definitions

`Analysis Ready Data`	Satellite data that have been processed to a minimum set of requirements and organized into a form that allows immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets.
`Granule`	A granule is the finest granularity of data that can be independently managed. A granule usually matches the individual file of EO satellite data.
`Collection`	A collection is an aggregation of granules sharing the same product specification. A collection typically corresponds to the series of products derived from data acquired by a sensor on board a satellite and having the same mode of operation.
`Interface`	Named set of operations that characterize the behavior of an entity.
`Metadata`	Information about a resource [RD02].

Metadata element	Discrete unit of metadata [RD02].

1.3.2 Acronyms

API	Application Programming Interface
ARD	Analysis Ready Data
CEOS	Committee on Earth Observation Satellites
CQL	Common Query Language
DIF-10	Directory Interchange Format Version 10
EO	Earth Observation
GCMD	Global Change Master Directory
HATEOAS	Hypertext As The Engine Of Application State
IDN	International Directory Network
JSON	JavaScript Object Notation
OGC	Open Geospatial Consortium
OSDD	OpenSearch Description Document
STAC	Spatiotemporal Asset Catalog
WGISS	Working Group on Information Systems and Services

1.4 References

1.4.1 Applicable documents

ID	Title
AD01	STAC Catalog Specification
AD02	STAC Collection Specification
AD03	STAC Item Specification
AD04	STAC API Specification
AD05	STAC API - Item Search
AD06	STAC API - Filter Extension
AD07	STAC API - Collection Search
AD08	OGC17-069r3, OGC API - Features - Part 1: Core
AD09	OGC17-079r1, OGC API - Features - Part 3: Filtering

ID	Title
AD10	OGC21-065, Common Query Language (CQL2)
AD11	RFC 7946 - The GeoJSON Format
AD12	JSON Schema: A Media Type for Describing JSON Documents, draft-handrews-json-schema-02
AD13	STAC Scientific Citation Extension Specification, v1.0.0
AD14	STAC Electro-Optical Extension Specification, v1.1.0
AD15	STAC SAR Extension Specification, v1.0.0
AD16	STAC Satellite Extension Specification, v1.0.0
AD17	STAC Versioning Indicators Extension Specification, v1.2.0
AD18	STAC View Geometry Extension Specification, v1.0.0
AD19	STAC Projection Extension Specification, v1.0.0
AD20	STAC Timestamps Extension Specification, v1.0.0
AD21	STAC Processing Extension Specification, v1.1.0
AD22	STAC Hyperspectral Imagery Extension Specification, draft
AD23	STAC Landsat Extension Specification, v1.1.1

1.4.2 Reference documents

ID	Title
RD01	CEOS OpenSearch Best Practice Document, Version 1.0, CEOS-OPENSEARCH-BP-V1.3
RD02	ISO 19115-1:2014, Geographic Information – Metadata – Part 1: Fundamentals, First Edition 2014-04-01
RD03	OGC23-038, Best Practice for Common Band Names of Optical and Radar Sensors - Expected but no draft available.
RD04	OGC13-026r9, OpenSearch Extension for Earth Observation

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2. Objectives and needs

Overview

The set of available STAC and STAC API specifications, the underlying OGC specifications and a growing set of related STAC and STAC API extensions can support many different use cases. However, the multiple implementation options for a given use case may cause organizations to implement different subsets of the specifications causing interoperability issues and preventing federation of catalogs provided by different organisations. The guidelines and recommendations presented in the current document aim to cover a number of recurrent use cases which are described below. Not all use cases apply to all organisations, but organisations with the need to cover one of these use cases should consider the corresponding recommendations.

Use cases and scenarios

In the current scenario where organisations (i.e. Data Providers) implement the CEOS OpenSearch Best Practices, federation is performed by systems (i.e. Federating Entities) such as IDN, NASA CMR or FedEO. The use cases identified below aim to continue to support such federation, but through the use of STAC (JSON) instead of XML-based OpenSearch with Atom responses.

User Story	***As a***	***I want to***	***So that I can***
UC-1	Data Provider	Publish my granule metadata records, e.g. on the cloud, organised per collection, without implementing search interfaces.	provide access to the metadata records to my data users.
UC-2	Data Provider	Publish my granule metadata records, organised per collection, and provide granule search interfaces (API).	provide access to the metadata records to my data users and offer eearch interfaces (API) they can use via scripts, curl or Notebooks.
UC-3	Data Provider	Publish my granule and collection metadata records and provide collection and granule search interfaces (API).	provide access to the metadata records to my data users and offer eearch interfaces (API) for collection and granule search they can use via scripts, curl or Notebooks.
UC-4	Data Provider	Publish my granule and collection metadata records and provide two-step search interfaces (API) similar to my current OpenSearch two-step-search interfaces.	offer my data users a two-step search capability.

User Story	***As a***	***I want to***	***So that I can***
UC-5	Data Provider	Publish my collection metadata records	make them available for federation through CEOS IDN or similar federated systems (e.g. GEO) without additional effort.
UC-6	Data Provider	Publish my granule metadata records and search interfaces	make them available for federation through CEOS IDN or GEO without additional effort.
UC-7	Data Provider	Publish collection metadata records for my analysis ready datasets	make them available for my users as per CEOS-ARD guidelines.
UC-8	Data Provider	Publish granule metadata records for my analysis ready datasets	make them available for my users as per CEOS-ARD guidelines.
UC-9	Federating entity	Provide federated access to collections and granules from a data partner	offer my users access to collections of that data partner (including granule search capabilities/interfaces if available) without requiring additional changes/effort at the data provider side.
UC-10	Data Provider	Publish metadata records for granules available in cloud-native format e.g. on cloud storage	make them available for my users
UC-11	Data Provider	Publish metadata records for granules with associated service offerings (e.g OGC WMS, WMTS, WCS, API-Coverages)	make the metadata records available for my users and advertise the availability of the associated service endpoints

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3. Granule Catalog Best Practices

3.1 Overview

How much information do we want to provide in the document. Not say anything about things which are explicit in the specifications (which ones?). Or we repeat certain info for clarity ?

syntax/structure of Best Practice identifiers is to be agreed. Current identifiers are preliminary. Obligation (requirement, recommendation) of each best practice is to be agreed as well. Current levels are "copy/paste" and not representative.

What terminology to use consistency in the requirements ? e.g. "A STAC server", "A CEOS STAC server", "A CEOS STAC [granule/collection] catalog implementation", catalog/catalogue, ...

Explain main alternatives :

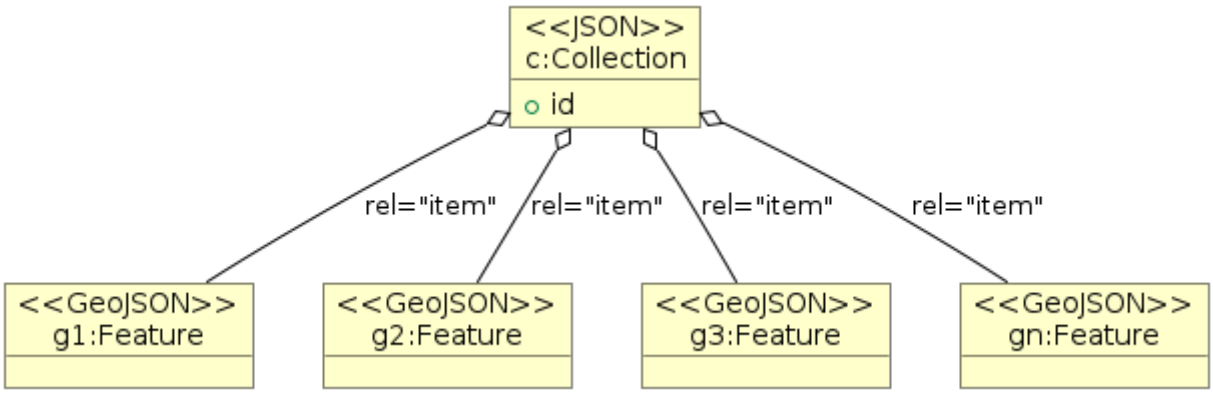
- static catalog (landing page, ..)
- catalog with search interface

3.2 Static catalog without search interface

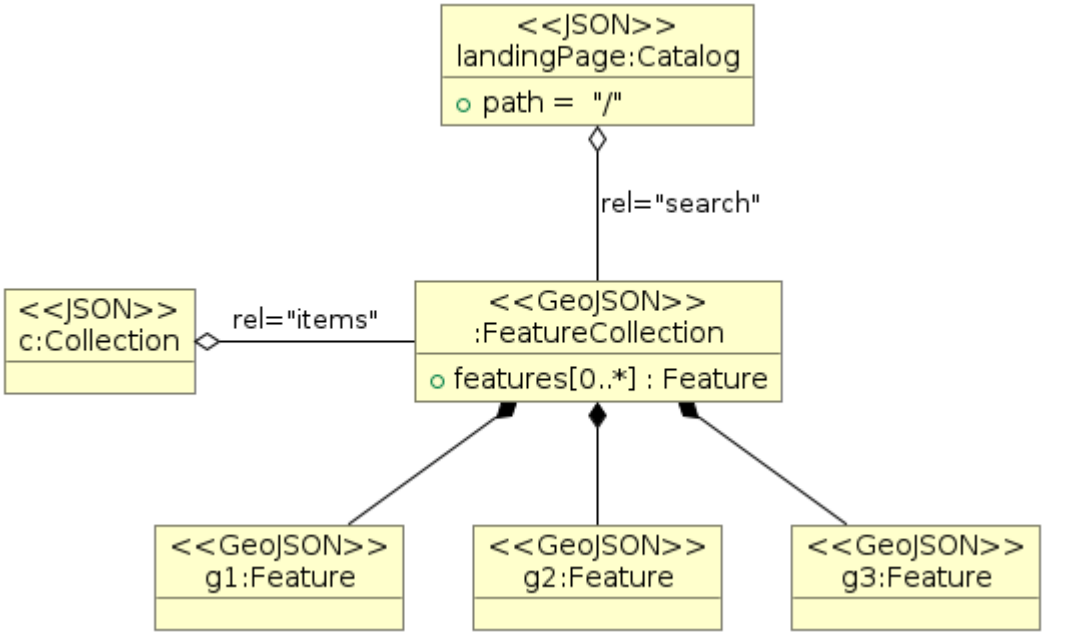
- rel="item"

EO granules represented as STAC items can be made available as:

- individual STAC items referenced from a STAC collection
- the result of a search interface



Method 1: Using rel="item"



Method 2: Via a search interface

3.3 Catalog with search interface

Granule search request

Endpoints

- endpoint(s): /search and/or /items ?
- GET and/or POST

Do we want to request the existence of 2 different endpoints for search, i.e. at /search and at /items even though just 1 is enough (partial compliance) ? For federation, it would be more scalable to ask for each collection to support search at rel="items".

Take note of this

Take note of this

Take note of this

> **CEOS-STAC-BP-002-3 - Granule search endpoints [Recommended]**
>
> CEOS implementations should advertise an endpoint for granule search which is valid for all the collections in the STAC Catalog (typically the Landing Page) with rel="search" and type="application/geo+json".

> **CEOS-STAC-BP-002-4 - Granule search endpoints [Recommended]**
>
> CEOS implementations should advertise an endpoint for granule search which is valid for a single collection in the STAC Collection representation as a Link object rel="items" and type="application/geo+json".

Search parameters

Advertising additional search parameters

- filter + CQL (optional)

Other

- Asset-level search capability (STFC)

Granule search response

- result navigation ?

> **CEOS-STAC-BP-10-2 - Item search response representation [Requirement]**
>
> An Item search response shall be represented as a GeoJSON FeatureCollection according to version v1.0.0 of the "STAC API ItemCollection Specification".

> **CEOS-STAC-BP-011B-2 - Result set navigation granules [Requirement]**
>
> The $.features[].links array in an item search response shall include Link objects for navigating the search result set when the result set is too large to fit a single response using hyperlinks rel='self', rel='next', rel='prev', rel='first', rel='last' and type=`application/geo+json`.

Use case	first	prev	self	next	last
First page	Optional	Not allowed	Mandatory	Mandatory	Optional
Middle pages	Optional	Optional	Mandatory	Mandatory	Optional
Last page	Optional	Optional	Mandatory	Not allowed	Optional
Empty result set	Not allowed	Not allowed	Mandatory	Not allowed	Not allowed
Single page	Optional	Not allowed	Mandatory	Not allowed	Optional

TBD

- simplifications ? /conformance, /api not required (even though mandatory) as not-used by clients - redundant ?

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4. Collection Catalog Best Practices

4.1 Overview

Explain main alternatives :

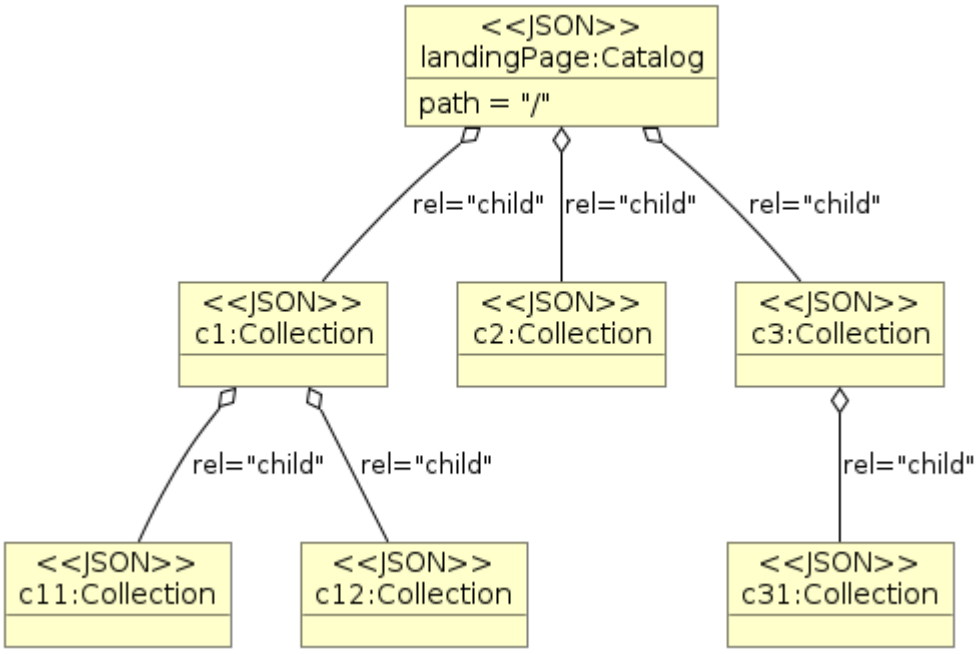
- static collection catalog (landing page, rel="child", rel="data", ..)
- collection catalog with search interface

The requirements in the current chapter only apply when TBD.

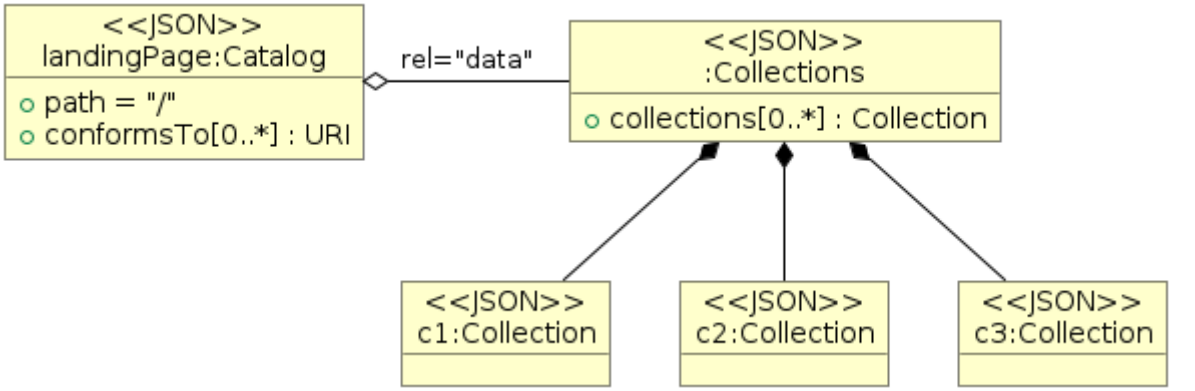
4.2 Collection catalog without search interface

EO collections represented as STAC collections can be made available as a STAC Catalog in different ways as depicted below:

- Through a hierarchy of catalogs or collections with the rel="child" relation.
- As a list of collections available via the rel="data" relation.



Method 1: Using rel="child"



Method 2: Using rel="data"

Implementations may combine both mechanisms and allow the same EO collection to be found via the collection hierarchy or the collection list. Implementations intending to support collection search are to support at least Method 2 and the corresponding endpoint.

> **CEOS-STAC-BP-TBD - Collection access [Requirement]**
>
> A STAC server shall support access to collection metadata from the catalog landing page using the rel="child" or rel="data" approach depicted above or both approaches combined.

Note: When publishing a single collection, the collection and the landing page may be combined in a single JSON file.

4.3 Collection catalog with search interface

> **CEOS-STAC-BP-TBD - API Feature paths [Permission]**
>
> A CEOS STAC server implementation is allowed to not use fixed paths to navigate from resource to resource, but shall support discovering the actual path via the proper relation (rel="xyz") in the corresponding resource's representation.

For example, the rel="items" path for a collection is not necessarily the path towards the collection with "/items" appended but may be on a different server.

> **CEOS-STAC-BP-TBD - API Feature relations [Permission]**
>
> A CEOS STAC server implementation is not required to:

- Support the /api path or provide an OpenAPI description of its interface
- Support the rel="service-desc" from its landing page (root catalog)
- Support the /conformance path
- Support the rel="conformance" from its landing page (root catalog)

> **CEOS-STAC-BP-002-1 - Collections endpoint [Requirement]**
>
> STAC servers supporting collection search shall advertise the search endpoint for collections in the landing page with rel="data" (most often `/collections`), type="application/json" and declare the corresponding collection search conformance classes in the landing page. See "STAC API Collection Search" [AD07].

The above endpoint is further referred to as the `collections endpoint`.

.Conformance encoding example

```
"conformsTo": [

    "http://www.opengis.net/spec/ogcapi_common-2/1.0/conf/collections",
    "http://www.opengis.net/spec/ogcapi-common-2/1.0/conf/simple-query",
    "http://www.opengis.net/spec/ogcapi-records-1/1.0/req/cql-filter",
    "https://api.stacspec.org/v1.0.0-rc.2/collection-search",
    "https://api.stacspec.org/v1.0.0-rc.2/collection-search#filter",
    "https://api.stacspec.org/v1.0.0-rc.1/collection-search#free-text",
    "http://www.opengis.net/spec/cql2/1.0/conf/cql2-text",
    "http://www.opengis.net/spec/cql2/1.0/conf/basic-cql2"
  ]
```

4.3.1 Collection search request

> **CEOS-STAC-BP-TBD - Collection search method [Requirement]**
>
> A STAC server shall support collection searches at the `collections endpoint` using the HTTP `GET` method.

Search parameters

> **CEOS-STAC-BP-005 - Supported search parameters [Requirement]**
>
> The STAC-API and OGC API-Features specifications define a list of fundamental search parameters. From these specifications, a CEOS STAC implementation shall support the following minimum set of search parameters for “collection” search at the collections endpoint:

- `limit`
- `ids`
- `bbox`
- `datetime`

> **CEOS-STAC-BP-TBD - Intersects search parameter [Permission]**
>
> A STAC server implementation may choose to not support the following search parameters for “collection” search at the collections endpoint:

- `intersects`

Free Text Keyword

> **CEOS-STAC-BP-003 - Free text search [Recommendation]**
>
> For supporting free text searches, the server shall advertise support for the HTTP query parameter `q` as in "STAC API Collection Search" [AD07].

Advertising additional search parameters

- rel="queryables", JSON Schema (optional)
- CQL (optional)

> **CEOS-STAC-BP-TBD - Additional search parameters [Recommendation]**
>
> A STAC server implementation supporting additional search parameters for collection search via a filter expression shall support the following additional query parameters and advertise the corresponding conformance classes in the landing page (See also "STAC API Filter Extension" [AD06].:
>
> - filter
> - filter-lang

> **CEOS-STAC-BP-TBD - CQL subset [Requirement]**
>
> A STAC server implementation supporting additional search parameters for collection search via a filter expression shall support at least the following conformance classes of CQL2 (See also "STAC API Filter Extension" [AD06] and "OGC21-065, Common Query Language (CQL2)" [AD10].:
>
> - CQL2 Text
> - Basic CQL2

> **CEOS-STAC-BP-TBD - Additional search parameter names [Recommendation]**
>
> A STAC server implementation supporting additional search parameters for collection search (e;g. search by platform, instrument, organisation) shall by preference use names consistent with the names defined in the OpenSearch extension for Earth Observation OGC 13-026r9 [RD04].

4.3.2 Collection search response

- result set navigation
- optional list of collection search parameters (rel="http://www.opengis.net/def/rel/ogc/1.0/queryables", type="application/schema+json"
- search by 'id' (at /collections), which 'ids' can be used for searching ? 'id' from hierarchy ?
- content negotiation (alternative formats)

> **CEOS-STAC-BP-011B-1 - Result set navigation collections [Recommendation]**
>
> The $.links array in a collection search response shall include Link objects for navigating the search result set or collection list when the result set is too large to fit a single response using hyperlinks rel='self', rel='next', rel='prev', rel='first', rel='last' and type=`application/json`.

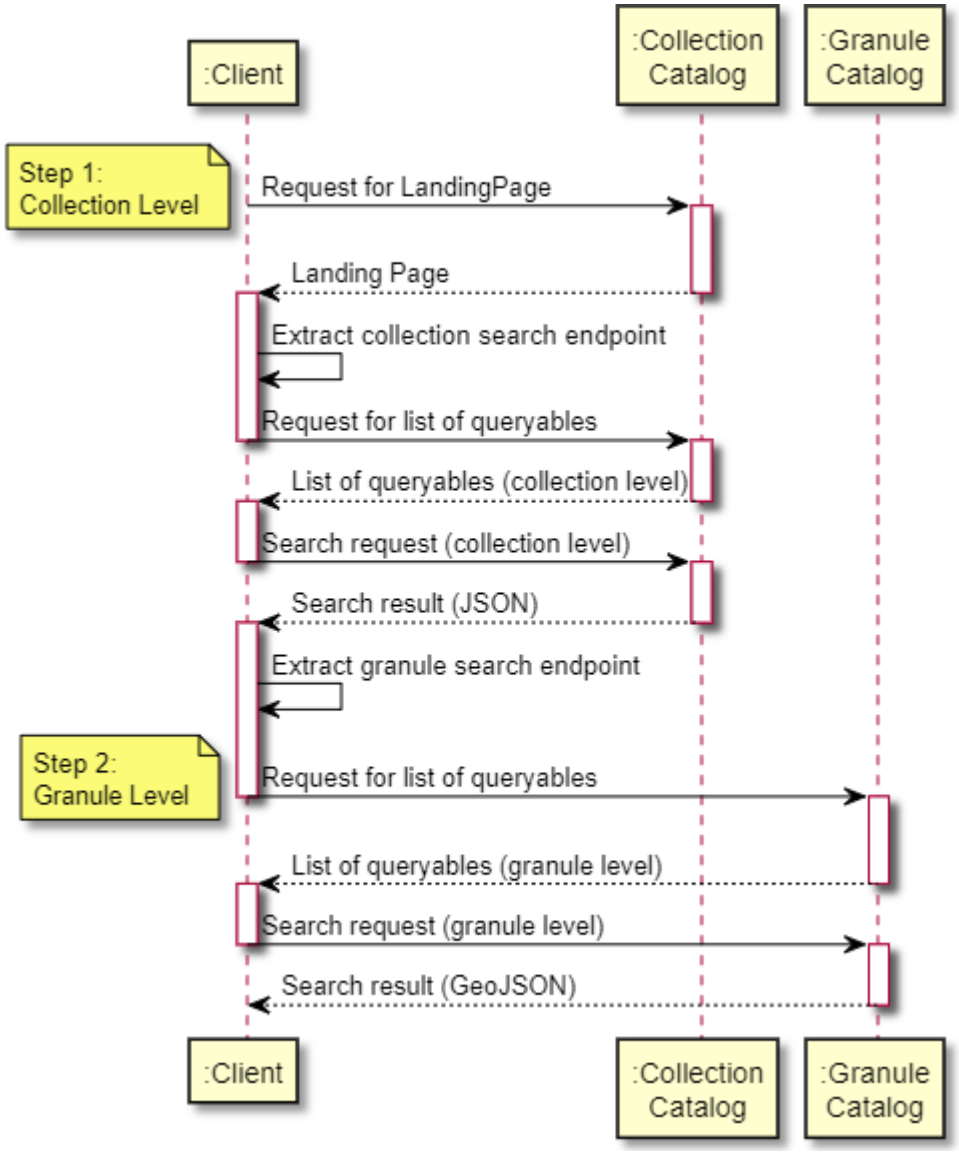
> **CEOS-STAC-BP-TBD - Collection queryables [Recommendation]**
>
> A STAC server implementation supporting additional queryables for collection search shall return the link to the Queryables object with the list of queryables that can be used in a filter expression via a link object in the collection search response with rel="http://www.opengis.net/def/rel/ogc/1.0/queryables" and type="application/schema+json" (See also "STAC API Collection Search" [AD07].

4.3.3 Two-step search

One serious hurdl"e to overcome in searching for data is the great number of data items to account for in responses, as well as the expected number of successful “hits” for a query. In ordinary web searches, the searcher is usually looking for a small number of web pages or documents. Relevance ranking typically does a good job of presenting these successful hits near the top of the returned list, followed by single point-and-click retrievals. However, when searching for Earth science data covering large time periods or spatial areas, a user will often specify a set of constraints to find an appropriate data collection together with space-time criteria for files within that data collection. Often, the precision of the data collections returned for the search is low, with many spurious hits. However, the space-time precision of the files is often quite high: that is, the user truly wants to use all the data files of a desirable data collection set that fall within the spacetime region of interest. Thus, searching for all data satisfying both dataset content and space-time region at the same time can produce a great many spurious hits, i.e., all the files for data collections that are not desired.

> **CEOS-STAC-BP-001 - Support of two step search [Recommendation]**
>
> Support for a two-step search consisting of a collection level search followed by a corresponding granule level search is recommended.

The two-step search consists of a collection level search and the subsequent granule level search (or file-level search).



Two Step Search

In order to provide a well-defined search path from a collection of interest to granules associated with that collection, we advocate the use of two-step searching leveraging the following:

1. Link elements of relation items (rel='items') within collection entries. These links point to a granule-level endpoint specific to the collection entry.
2. Link elements of relation queryables (rel='queryables') within collection entries. These links point to available granule-level search parameters specific to the collection entry.
3. Granule level interface descriptions (i.e. endpoints and sets of search parameters) that can be tailored to a specific collection.

The advantages of this approach are as follows:

- A client can navigate from collection to granule with only an understanding of the STAC specification.
- A server links between collections and granules exploiting the relation between a STAC Collection and a STAC Item.
- It allows the client to determine what search parameters are available to the user at the granule level using the /queryables response.

❓	**To be clarified what assumptions a STAC client is allowed to make regarding available (granule) search parameters. Are STAC item-search parameters always all available at /search and /items endpoints, or only at the /search endpoint ?**
❓	**What STAC collection ìdentifiers can be used to perform searches at the /search endpoint ? All the ones available at the rel=`data` path, all the ones in the hierachical structure starting from the landing page following the rel=`child` links ? ?**
❓	**What is the relation between the collections appearing in the hierarchy rel=`child` and the response from the /collections (rel=`data`) endpoint ? One is a subset of the other or both can be unrelated ? /collections to return a flat list ? and how is it "filtered" when a query is applied ? Flat list of all matches ?**

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5. Granule Metadata Best Practices

Overview

Explain main parts

Properties

- mandatory/recommended properties / extensions
- refer to mapping between STAC and OS-EO properties. (DLR)

> **CEOS-STAC-BP-XXX - Granule representation [Requirement]**
>
> A(n EO) Granule metadata record shall be represented as a STAC Item according to version v1.0.0 of the "STAC Item Specification" [AD03].

> **CEOS-STAC-BP-013B - Temporal extents [Recommended]**
>
> STAC implementations should represent temporal extents in Items with the `start_datetime` and `end_datetime` properties and include the value for `start_datetime` also as `datetime` property.

> **CEOS-STAC-BP-014 - Geographical extents [Requirement]**
>
> STAC implementations shall represent geographical extents of Items with the `geometry` property (GeoJSON Geometry object or null if not available).

Geographical extents of Items are represented using GeoJSON geometry objects RFC7946 in STAC item search responses. This representation can natively represent multi-point, multi-line and multi-polygon geometries, thus no additional guidance similar to `CEOS-BP-014B`, `CEOS-BP-014C` and `CEOS-BP-014D` is required.

> **CEOS-STAC-BP-014E - Minimum-bounding rectangle [Requirement]**
>
> CEOS implementations should render spatial extents using a minimum-bounding rectangle (MBR) with a GeoJSON `bbox` property RFC7946 in addition to the native more accurate representation of that extent with the `geometry` property. The value of the bbox element must be an array of length 4 (two long/lat pairs), with the southwesterly point followed by the northeasterly point.

The `bbox` item property is mandatory according to the STAC Item specification unless `geometry` is null.

Assets and roles

- what names (roles, media types) should be used for quicklooks, bands, ...

For various associations, both Assets and Links can be used. To avoid redundancy the Best Practice should make a recommendation and not request that both are implemented. This is future work.

> **CEOS-STAC-BP-TBD - Metadata assets [Requirement]**

> If a resopurce association can be encode as Assets or Link (e.g. rel="icon", rel="alternate"), STAC implementations shall give precedence to the encoding as Asset.

> **CEOS-STAC-BP-012-2 - Metadata assets [Requirement]**
>
> STAC implementations shall provide a URL to the granule's (or collection) metadata encoding in a particular standard representation, via an Asset object with role=`metadata`.

> **CEOS-STAC-BP-012E - Link and Asset type attributes [Recommended]**
>
> STAC implementations shall specify the media (MIME) type of the artifact associated with a resource by specifying the "type" attribute of the Link object or Asset object.

The table below list some frequently used formats and the corresponding media type (`type`) to be used for metadata assets.

Format	type
ISO19139	`application/vnd.iso.19139+xml`
ISO19139-2	`application/vnd.iso.19139-2+xml`
ISO19115-3	`application/vnd.iso.19115-3+xml`
ISO19157-2	`application/vnd.iso.19157-2+xml`
OGC 10-157r4	`application/gml+xml;profile=http://www.opengis.net/spec/EOMPOM/1.1`
OGC 17-003r2	`application/geo+json;profile=http://www.opengis.net/spec/eo-geojson/1.0`
Dublin Core	`application/xml`
Markdown	`text/markdown`

> **CEOS-STAC-BP-015 - Browse image [Recommended]**
>
> STAC implementations should provide a URL to the granule's browse image when available, via an Asset object with role=`overview`.

> **CEOS-STAC-BP-TBD - Thumbnail image [Recommended]**
>
> STAC implementations should provide a URL to the granule's thumbnail image when available, via an Asset object with role=`thumbnail`.

> **CEOS-STAC-BP-016 - Data access [Recommended]**
>
> STAC implementations should provide data access URL for the granule via an Asset object with role=`data`.

.Example: Asset object for Cloud Optimized GeoTIFF data

```
"assets": {
        "analytic": {
            "href": "https://storage.googleapis.com/sample-
```

```
cogs/cog/20210515_145754_03_245c_3B_AnalyticMS.tif",
            "type": "image/tiff; application=geotiff; profile=cloud-optimized",
            "title": "4-Band Analytic",
            "roles": [
                "analytic", "data"
            ]
        }
```

.Example: Asset object for Zarr data

```
 "assets": {
    "zmetadata": {
      "roles": [
        "data",
        "metadata",
        "zarr-consolidated-metadata"
      ],
      "description": "Consolidated metadata file for Zarr store",
      "href":
"https://storage.sbg.cloud.ovh.net/v1/AUTH_d40770b0914c46bfb19434ae3e97ae19/hdsa-
public/prisma_v2/20200410/.zmetadata",
      "type": "application/json"
    },
```

> **CEOS-STAC-BP-016B - Data access to multiple files [Recommendation]**
>
> When data access to a granule in a granule search response is to be provided in multiple physical files, each file should be linked to via a separate Asset object with role=`data`.

> **CEOS-STAC-BP-TBD - Common band names [Recommendation]**
>
> If access to individual bands is provided via assets, then Common Band Names should be used, preferably according to the forthcoming OGC Best Practice document [RD03].

> **CEOS-STAC-BP-TBD - Asset roles [Recommendation]**
>
> If aditional asset roles are required (e.g. for cloud marks, snow masks etc), preference shall be given to the asset role names of the corresponding Best Practices.

Links and relations

- how to encode "offerings" (i.e. links to OGC or other service endpoints in a STAC item) ?
- how to encode cloud-native access (zarr, COG) in STAC item.
- how to encode different resource access methods e.g. http download link or S3 location url
- how/when to use the asset alternate links extension?
- Recommendation to properly link to all (raster) assets in an EO product. (VITO)

> **CEOS-STAC-BP-012-1 - Reference to metadata [Recommended]**

> STAC implementations should include Link objects in Items or Collections with rel="alternate" or rel="via" for detailed representation of the metadata. (The "via" relation should be preferred to convey the authoritative resource or the source of the information from where the Item or Collection is made.)

> **CEOS-STAC-BP-012C - Reference to documentation [Recommended]**
>
> STAC implementations should use a Link object with rel="describedby" to reference from a collection to its documentation or from an item to its documentation.

Note: although some implementations use rel="about" for the same purpose, rel="describedby" is recommended by https://docs.ogc.org/DRAFTS/20-024.html.

Facilitating catalog federation

> **CEOS-STAC-BP-TBD - Root relation [Recommendation]**
>
> It is discouraged to use the rel="root" relation in STAC item encodings as the item's original data provider's catalog/collections maybe included in a federated catalog with a different root.

CEOS-ARD recommendations

- TBD

Previous

6. Collection Metadata Best Practices

6.1 Overview

Explain main parts

6.2 Properties

- ...
- summaries (platform, instrument, science keywords, GCMD)
- organisation objects with names/URL from GCMD ?

> **CEOS-STAC-BP-XXX - Collection representation [Requirement]**
>
> A(n EO) Collection metadata record shall be represented as a STAC Collection according to version v1.0.0 of the "STAC Collection Specification" [AD02].

> **CEOS-STAC-BP-XXX - Platform information [Requirement]**
>
> A(n EO) Collection metadata record shall encode the platform name(s) as $..summaries.platform property and use the platform name corresponding to the GCMD platform preferred label.

> **CEOS-STAC-BP-XXX - Instrument information [Requirement]**
>
> A(n EO) Collection metadata record shall encode the instrument name(s) as $..summaries.instruments property and use the instrument names corresponding to the GCMD instrument preferred label.

> **CEOS-STAC-BP-XXX - Science keywords [Requirement]**
>
> A(n EO) Collection metadata record shall encode related science keywords as $.keywords property and use the science keywords corresponding to the GCMD Earth Science) preferred label.

```
"keywords": [
    "EARTH SCIENCE>AGRICULTURE",
    "EARTH SCIENCE>BIOSPHERE>ECOSYSTEMS>TERRESTRIAL ECOSYSTEMS>FORESTS",
    "EARTH SCIENCE>LAND SURFACE",
    "EARTH SCIENCE>BIOSPHERE>VEGETATION" ],

"summaries": {
    "instruments": [
      "AVNIR-2",
      "SLIM6",
      "MSC"
    ],
    "platform": [
      "ALOS-1",
      "GEOSAT-1",
      "KOMPSAT-2"
```

```
      ]
    }
```

> **CEOS-STAC-BP-XXX - DOI [Requirement]**
>
> The DOI of a collection, if available, shall be encoded according to the Scientific Citation Extension Specification, i.e. using the `sci:doi` property and a link object with rel="cite-as" [AD13].

6.3 Assets and roles

- what names (roles, media types) should be used for ...

6.4 Links and relations

- how to encode "offerings" (i.e. links to OGC or other service endpoints in a STAC collection) ?

> **CEOS-STAC-BP-TBD - Reference to metadata [Recommended]**
>
> STAC implementations should include Link objects in Collections with rel="alternate" or rel="via" for detailed representation of the metadata. (The "via" relation should be preferred to convey the authoritative resource or the source of the information from where the Collection is made.)

> **CEOS-STAC-BP-TBD - Reference to documentation [Recommended]**
>
> STAC implementations should use a Link object with rel="describedby" to reference from a collection to its documentation.

Note: although some implementations use rel="about" for the same purpose, rel="describedby" is recommended by https://docs.ogc.org/DRAFTS/20-024.html.

The table below list some frequently used formats for metadata standards or documentation and their corresponding media type (`type`).

Format	type
DIF10	`application/dif10+xml`
ISO19139	`application/vnd.iso.19139+xml`
ISO19139-2	`application/vnd.iso.19139-2+xml`
ISO19115-3	`application/vnd.iso.19115-3+xml`
ISO19157-2	`application/vnd.iso.19157-2+xml`
OGC 17-084r1	`application/geo+json;profile=http://www.opengis.net/spec/eoc-geojson/1.0`
Dublin Core	`application/xml`
Markdown	`text/markdown`
PDF	`application/pdf`

6.5 Facilitating catalog federation

- make available DIF10 metadata record as "asset" (for IDN) ?

> **CEOS-STAC-BP-TBD - Root relation [Recommendation]**
>
> It is discouraged to use the rel="root" relation in STAC collection encoding as the collection's original data provider's catalog/collections may be included in a federated catalog with a different root.

6.6 CEOS-ARD recommendations

- TBD