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CEOS Working Group  
on Information Systems and Services

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**WGISS Connected Data Assets**  
**Client Partner Guide (OpenSearch)**

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## 1. Introduction

This document contains the comprehensive client partner’s guide for OpenSearch, as adopted in the CEOS WGISS Connected Data Assets project. The document introduces the architecture background and required skills to be a client, the query interface, and an implementation outline. Several detailed use cases about how to retrieve the IDN (International Directory Network) dataset ID and how to interact with the WGISS Connected Assets Granule Gateway servers are also included in this document.

## 2. Scope

This client partner guide applies to the CEOS WGISS Connected Data Assets. This client partner guide is applicable to both CWIC and FedEO instances, as well as potential other data partners.

The target audience for this document is the community of software developers who are:

- a) Implementers of IDN OpenSearch
- b) Implementers of CEOS Best Practices-compliant OpenSearch server
- c) Implementers of CEOS Best Practices OpenSearch client

## 3. References

The following documents provide more background and supportive information.

Document Reference & Version	Document Title / Description
CWIC-DOC-17-002r01	CWIC Client Partner Guide (OpenSearch)
OGC 10-157r4	Earth Observation Metadata profile of Observations & Measurements, Version 1.1
OGC 10-032r8	OpenSearch Geo and Time Extensions
OGC 13-026r8	OpenSearch Extension for Earth Observation

## 4. Before You Begin

This chapter introduces the background, concepts and architecture of IDN, CWIC, and FedEO, within the scope of the WGISS Connected Assets. The related skills you will need as a client partner are also discussed.

### 4.1. WGISS Connected Data Assets Background

For scientists who conduct multi-disciplinary research, there may be a need to search multiple catalogs in order to find the data they need. Such work can be very time-consuming and tedious, especially when different catalogs may use different metadata models and catalog interface protocols. It would be desirable, therefore, for those catalogs to be integrated into a catalog federation which will present a well-known and documented metadata model and interface protocol to users and hide the complexity and diversity of the affiliated catalogs behind the interface. With such a federation, users only need to work with the federated catalog through the public interface or API to find the data they need instead of working with various catalogs individually.

The Committee on Earth Observation Satellite (CEOS) addresses coordination of the satellite Earth Observation (EO) programs of the world's government agencies, along with agencies that receive and process data acquired remotely from space. The Working Group on Information Systems and Services (WGISS) is a subgroup of CEOS, which aims to promote collaboration in the development of systems and services that manage and supply EO data to users world-wide.

NASA's contributions to the Committee on Earth Observation Satellites (CEOS) International Directory Network (IDN) provides access to more than 34,000 Earth science data set and service descriptions (stored in the Common Metadata Repository [CMR]) which cover subject areas within Earth and environmental sciences. The IDN's mission is to assist researchers, policy makers, and the public in the discovery of and access to data and related services relevant to Earth science research.

To aid in the search and discovery effort, Global Change Master Directory (GCMD) controlled keywords have been developed and are regularly being refined and expanded. These keywords are also used in other applications within the broader scientific community. Users may perform searches through the IDN website and OpenSearch API using the controlled keywords, free-text searches, map/date searches, or any combination of the above; and may also search or refine a search by data center, instrument, platform, project, or temporal/spatial resolution.

The IDN also supports docBUILDER, a web-based metadata authoring tool that allows metadata authors to add (or modify) data set descriptions (DIFs) that comply with the CMR Unified

Metadata Model for Collections (UMM-C). The tool also allows metadata authors to validate and submit their DIF-10 records directly for discovery in the IDN.

To realize a federated catalogue for data discovery from multiple EO data centers, the CEOS WGISS Integrated Catalog (CWIC) system has been implemented. CWIC was initiated and supported by NASA, NOAA, and USGS as a contribution to CEOS. CWIC provides inventory search to WGISS agency catalog systems for EO data by distributing search requests to the appropriate server and sending search responses back to the requesting client. CWIC will provide translation from the CEOS OpenSearch search request to the native protocol used by the data partner server if the data partner system does not implement CEOS OpenSearch.

FedEO (Federated Earth Observation Gateway) provides a unique entry point to a growing number of scientific catalogues and services for, but not limited to, EO European and Canadian missions. FedEO is deployed with ESA (European Space Agency) infrastructure as a gateway to provide brokered discovery, access and ordering capability to European/Canadian EO missions data based on HMA (Heterogeneous Missions Accessibility) interfaces.

WGISS is now coordinating efforts to connect CWIC and FedEO system with the IDN through a common registration of metadata records to seamlessly provide search results for relevant data sets regardless of which system is used to access the granule level data.

## **4.2. Search Concept and Design**

A two-step collection/granule search process, which separates discovery of data collections from searching within relevant data collections to retrieve specific data granules, has been adopted to realize the integrated access to heterogeneous, autonomous data sources.

The WGISS Connected Data Assets system is an implementation of this two-step process. The IDN provides an OpenSearch front end to the collection search. The response from the collection search includes links to the OpenSearch Descriptor Documents (OSDD) at one of several Granule Gateways, providing search capability for granules at the relevant data providers. Current WGISS Connected Data Assets Granule Gateways include the CWIC and FedEO systems. Each of these systems provides access to different data archive systems using the same OpenSearch protocol. Spatial and temporal metadata are the only attributes guaranteed to be supported at all data providers. The CEOS OpenSearch Best Practice supports a lot of metadata attributes through the Parameter extensions, but they are not all universally supported across CWIC or FedEO.

### **4.2.1 Collection Search Criteria**

CEOS OpenSearch is used as the IDN's collections search implementation based on the OpenSearch 1.1 (Draft 5) specification and is compliant with the CEOS OpenSearch Best Practices. The IDN OpenSearch API allows clients to formulate OpenSearch compliant queries against the IDN collections and specify the desired search results format as OpenSearch

compliant ATOM or HTML. The IDN OpenSearch API has implemented the following search fields for users' queries:

- boundingBox
- campaign
- endTime
- geometry
- instrument
- keyword
- placeName
- processingLevel
- satellite
- sensor
- startTime
- uid

Also, client developers are able to query with specific tags: isCeos, isCwic, isGeoss, and isFedEO. Tagging allows arbitrary sets of collections to be grouped under a single namespace value. The sets of collections can be recalled later when searching by tag fields.

IDN query examples:

- GET the first 10 IDN collections with results in the ATOM format: <http://cmr.earthdata.nasa.gov/opensearch/collections.atom?numberOfResults=10&clientId=cswOpenSearchDoc>
- GET the first 10 IDN collections containing the GCMD instrument keyword MODIS with results in the ATOM output format: <https://cmr.earthdata.nasa.gov/opensearch/collections.atom?instrument=MODIS&numberOfResults=10&clientId=cswOpenSearchDoc>
- GET the first 10 CWIC IDN collections containing the GCMD instrument keyword MODIS with results in the HTML format: <https://cmr.earthdata.nasa.gov/opensearch/collections?instrument=MODIS&isCwic=true&numberOfResults=10&clientId=cswOpenSearchDoc>

### 4.2.2 Granule Search Criteria

Section 5 (below) gives complete details about the OpenSearch API for specifying search criteria. It is important to understand how the OSDD documents search parameters both for data collections and, separately, for granules.

The step 2 search, i.e. granule search, supports constraints with spatial, temporal, and pagination. Spatial constraint is specified with a bounding box. Temporal filter can be specified with begin and end time in standard ISO 8601 timestamp format. See Section 5 for specific query parameters.

### 4.2.3 Current Data Partners

Current data partners providing granule search access through WGISS Connected Data Assets include systems from the following agencies: National Space and Aeronautics Agency (NASA), the European Space Agency (ESA), the National Centers for Environmental Information (NCEI) of National Oceanic Atmosphere Agency (NOAA), the Group for High Resolution Sea Surface Temperature (GHRSSST) of NOAA, United States Geological Survey (USGS), the National Institute for Space Research (INPE) of Brazil, the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the Canada Centre for Mapping and Earth Observation (CCMEO), the Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC) of the Indian Space Research Organisation (ISRO), and the National Remote Sensing Center (NRSC) of ISRO and the National Remote Sensing Center of China (NRSCC). WGISS maintains a current list of the data providers that comprise the WGISS Connected Data Assets on the WGISS website.

## 4.3. WGISS Architecture for Connected Data Assets

At its core, the systems present to End Users and Clients an OpenSearch server compliant with the CEOS OpenSearch Best Practice. In this way, outside clients need to have no specific knowledge of the particular partner data systems and communicate only via OpenSearch.

## 4.4. Skills You Will Need as a Client Partner

As a Client Data Partner, you need to be familiar with basic web application technology such as:

- XML and XML Schema (XSD<sup>1</sup>)
- OpenSearch<sup>2</sup> related technologies

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<sup>1</sup> XML Schema: [http://en.wikipedia.org/wiki/XML\\_Schema\\_%28W3C%29](http://en.wikipedia.org/wiki/XML_Schema_%28W3C%29)

<sup>2</sup> OpenSearch specification version 1.1 draft 5 (<http://www.opensearch.org/Specifications/OpenSearch/1.1>)

- RESTFul<sup>3</sup> related architecture and technologies
- Web development programming language

#### **4.5. WGISS Connected Data Assets Terms and Definitions**

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

**(1) catalog ID**

Identifiers of data provider serving granule metadata

**(2) client**

A software component that can invoke an operation from a server

**(3) CMR**

The Common Metadata Repository is the database system used to manage earth science metadata records for the IDN.

**(4) collection**

A grouping of granules that all come from the same source, such as a modeling group or institution. Collections have information that is common across all the granules they "own" and a template for describing additional attributes not already part of the metadata model.

**(5) data clearinghouse**

The collection of institutions providing digital data, which can be searched through a single interface using a common metadata standard

**(6) dataset**

Has the same meaning as collection, see (10)

**(7) GCMD**

The Global Change Master Directory (GCMD) is a gateway to US-based earth science data and services

**(8) granule**

The smallest aggregation of data that can be independently managed (described, inventoried, and retrieved). Granules have their own metadata model and support values associated with the additional attributes defined by the owning collection.

**(9) Granule Gateway**

A CEOS OpenSearch compliant server providing access to remote data partner inventory

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<sup>3</sup> RESTFul: [http://en.wikipedia.org/wiki/Representational\\_state\\_transfer](http://en.wikipedia.org/wiki/Representational_state_transfer)



systems.

**(10) granule ID**

A character string that uniquely identifies a single granule to a granule gateway

**(11) identifier**

A character string that may be composed of numbers and characters that is exchanged between the client and the server with respect to a specific identity of a resource

**(12) IDN**

The CEOS International Directory Network (IDN) is a gateway to Earth Science data and services.

**(13) IDN dataset ID**

Unique dataset identifier in IDN, returned from the IDN in response to the OSDD request. This identifier is assigned by the IDN CMR database.

**(14) native ID**

Dataset identifier used by CWIC and FEDEO to retrieve granule metadata through data provider API. This identifier is assigned by the data provider but may be the same as the IDN dataset ID.

**(15) operation**

The specification of a transformation or query that an object may be called to execute

**(16) OSDD**

OpenSearch Descriptor Document

**(17) profile**

A set of one or more base standards and - where applicable - the identification of chosen clauses, classes, subsets, options and parameters of those base standards that are necessary for accomplishing a particular function

**(18) request**

The invocation of an operation by a client

**(19) response**

The result of an operation, returned from server to client

## **4.6. IDN Systems**

The IDN, CMR OpenSearch (for IDN), and the GCMD's Keyword Management Service (KMS)

only have operational systems which end-users can access.

- IDN site is available to all users.  
Location: <http://idn.ceos.org/>
- OpenSearch API for IDN (via CMR) - production instance is available to all users.  
Location: <https://cmr.earthdata.nasa.gov/opensearch/>
- KMS - production instance is available to all users.  
Location:  
<https://wiki.earthdata.nasa.gov/display/gcmdkey/Keyword+Management+Service+Application+Program+Interface#KeywordManagementServiceApplicationProgramInterface-1Introduction>

The IDN site search interface and the CMR OpenSearch production instances will provide access to all datasets which have been registered in the IDN. The KMS production instance will provide access to all approved GCMD keywords registered by IDN providers.

#### 4.7. CWIC Systems

There are two operational CWIC systems to which end-users have access.

- CWIC PROD – this is CWIC production instance and is available to all users.  
Location: <http://cwic.wgiss.ceos.org/>
- CWIC TEST – this is CWIC testing instance used by data partners and CWIC clients to perform testing before changes are made to the CWIC production instance.  
Location: <http://cwictest.wgiss.ceos.org/>

The production instance will provide access to only datasets which have been registered with the IDN and verified to be at least minimally compliant. The TEST instance may provide access to additional datasets (*e.g.*, new datasets undergoing testing and not yet registered in the IDN), and capabilities which have not yet been tested sufficiently to move to the production system.

#### 4.8. FedEO Systems

There are two operational FedEO systems to which end-users have access.

- FedEO PROD – this is FedEO production instance and is available to all users.  
Location: <http://fedeo.esa.int/opensearch/description.xml>
- FedEO TEST – this is FedEO testing instance used by data partners and external clients to perform testing before changes are made to the FedEO production instance.

Location: <http://geo.spacebel.be/opensearch/description.xml>

The production instance will provide access to datasets registered in the IDN and verified to be at least minimally compliant. The TEST instance may provide access to additional datasets (*e.g.*, new datasets undergoing testing and not yet registered in the IDN), and capabilities which have not yet been tested sufficiently to move to the production system.

## 4.9. Contact Information

All the documents and information about WGISS Connected Data Assets are available at WGISS page at

<http://wgiss.ceos.org>

Any questions regarding to WCDA, please send the email to

[Access-SysTeam-help@wgiss.ceos.org](mailto:Access-SysTeam-help@wgiss.ceos.org)

## 5. OpenSearch Query Interface

The Query Interface stipulates the protocol between client and catalog server.

### 5.1. Obtaining the OpenSearch Description Document (OSDD)

OpenSearch Description Documents (OSDDs) provide necessary information for clients to programmatically formulate valid search requests. Specifically, clients are expected to acquire both the cardinality and the domain of request parameters based on the query template in the OSDD. Dataset valids (*i.e.* spatial footprint and temporal extent) are also provided in the OSDD in both machine parsable and human readable formats. Dataset valids enable clients to formulate valid requests yielding more accurate results.

The federated system provides both generic and dataset specific OSDDs. Clients are able to fetch a generic OSDD through the CWIC or FedEO OSDD endpoint. The OSDD request must also include a client identifier string, as recommended by the CEOS OpenSearch Best Practices. Clients are also able to retrieve a dataset-specific OSDD through the OSDD endpoint by sending both client ID and dataset identifier. In a dataset specific OSDD, the domain is provided for some parameters (*e.g.*, timeStart and timeEnd) in addition to the request parameter syntax.

Generic OSDD request URL example (CWIC):

<http://cwic.wgiss.ceos.org/opensearch/datasets/osdd.xml?clientId=sampleClient>

Generic OSDD request URL example (FedEO):

<http://fedeo.esa.int/opensearch/description.xml>

Dataset specific OSDD request URL example (CWIC):

[http://cwic.wgiss.ceos.org/opensearch/datasets/C1235542031-USGS\\_LTA/osdd.xml?clientId=sampleClient](http://cwic.wgiss.ceos.org/opensearch/datasets/C1235542031-USGS_LTA/osdd.xml?clientId=sampleClient)

Dataset specific OSDD request URL example (FedEO):

<http://fedeo.esa.int/opensearch/description.xml?parentIdentifier=EOP:ESA:FEDEO:COLLECTIONS:CryoSat.products>

Fig. 1 Examples of OSDD requests

## 5.2. Search request

CEOS OpenSearch supports both searching for data collections through the IDN and for granules in a specific dataset at one of the data partners. It executes a collection or inventory search, as appropriate, and returns the matching results.

In order to initialize a valid request, clients will fill request parameters with proper values and set the dataset identifier. The template of the OpenSearch request is available under the <Url> element in OSDD. Both cardinality and domain of request parameters to be extracted from the OSDD are listed as follows:

Request Parameter <sup>a</sup>	Description <sup>b</sup>	Value & Cardinality (M) = mandatory (O) = optional	Type <sup>c</sup>
datasetId	Dataset identifier	(M) Allowed value is IDN dataset ID	cwic <sup>d</sup> :datasetId
geoBox	Returned granules will have a spatial extent overlapping this bounding box	(O) Supported formats are in W,S,E,N coordinate order: W: WestBoundingLongitude S: SouthBoundingLatitude E: EastBoundingLongitude N: NorthBoundingLatitude All coordinates are in EPSG:4326	geo <sup>e</sup> :box
timeStart	Returned granules will have a	(O)	time <sup>f</sup> :start

	temporal extent containing this start time	Supported formats are: 'yyyy-MM-dd', 'yyyy-MM-ddTHH:mm:ssZ' or 'yyyy-MM-dd HH:mm:ss'	
timeEnd	Returned granules will have a temporal extent containing this end time	(O) Supported formats are: 'yyyy-MM-dd', 'yyyy-MM-ddTHH:mm:ssZ' or 'yyyy-MM-dd HH:mm:ss'	time <sup>f</sup> :end
startIndex	Starting record number of the set of search results desired by the search client	(O) Allowed value is any integer equal and greater than '1'.	os <sup>g</sup> :startIndex
count	Number of search results per page desired by the search client	(O) Allowed value is any integer within the interval of [1,200].	os <sup>g</sup> :count
clientId	The identifier of client	(O) Allowed value is any URL well-formed string representing client identifier.	esipdiscover <sup>h</sup> :clientId
<p>a: All request parameters are case sensitive                  b: "Definition" represents the semantic meaning of request parameter.                  c: "Type" represents request parameter type restricted by namespace.                  d: <a href="http://cwic.wgiss.ceos.org/opensearch/extensions/1.0/">http://cwic.wgiss.ceos.org/opensearch/extensions/1.0/</a>                  e: <a href="http://a9.com/-/opensearch/extensions/geo/1.0/">http://a9.com/-/opensearch/extensions/geo/1.0/</a>                  f: <a href="http://a9.com/-/opensearch/extensions/time/1.0/">http://a9.com/-/opensearch/extensions/time/1.0/</a>                  g: <a href="http://a9.com/-/spec/opensearch/1.1/">http://a9.com/-/spec/opensearch/1.1/</a>                  h: <a href="http://commons.esipfed.org/ns/discovery/1.2/">http://commons.esipfed.org/ns/discovery/1.2/</a></p>			

Table 1 Table of CWIC OpenSearch request parameters

### 5.3. Search response

A CEOS OpenSearch response is an ATOM<sup>4</sup> feed with zero or more ATOM entries. Each entry represents metadata pertaining to single granule with submitted query.

Namespaces referred in the OpenSearch response are listed as follows:

Namespace	URL
xmlns:atom	<a href="http://www.w3.org/2005/Atom">http://www.w3.org/2005/Atom</a>

<sup>4</sup> Atom syndication format (<http://tools.ietf.org/search/rfc4287>)

xmlns:opensearch	http://a9.com/-/spec/opensearch/1.1/
xmlns:dc	http://purl.org/dc/elements/1.1/
xmlns:georss	http://www.georss.org/georss/10
xmlns:geo	http://a9.com/-/opensearch/extensions/geo/1.0/
xmlns:time	http://a9.com/-/opensearch/extensions/time/1.0/
xmlns:cwic	http://cwic.wgiss.ceos.org/opensearch/extensions/1.0/
esipdiscover	http://commons.esipfed.org/ns/discovery/1.2/

Table 2 Table of CWIC OpenSearch namespaces

**ATOM <feed> element**

Element	Value
atom: title	Atom feed title element
atom: updated	Date tag indicating when granule metadata is returned from data provider
atom: author	Fixed value, which is the contact information of supporting team, <i>e.g.</i> <author> <name>...</name> <email>...</email> </author>
atom: id	Fixed value for granule unique identifier
opensearch: totalResults	Number of records matched
opensearch: startIndex	Number of start record desired by client
opensearch: itemsPerPage	Actual number of returned items per page
opensearch: Query	Query element recording actual request parameter values from client
atom: link	Traversal link. Supported 'rel' attribute values include: first: link to the first granule last: link to the last granule previous: link to previous granule, where applicable next: link to next granule, where applicable search: link to CWIC OSDD endpoint self: link of submitted CWIC OpenSearch request

Table 3 Table of Atom <feed> element

**ATOM <entry> element**

Element	Value
atom: title	Descriptive title for the granule
atom: id	Unique identifier of the granule within the local catalog system
atom: updated	Date tag indicating when granule metadata is last updated by data provider
atom: author	Fixed value, which is the contact information of data provider
spatial extent elements	For each granule, at least one <georss:box> will be provided to represent the

	<p>minimum bounding rectangle of spatial extents of granule. &lt;georss:box&gt; is formatted with coordinate order of WestBoundingLongitude, SouthBoundingLatitude, EastBoundingLongitude, NorthBoundingLatitude. All coordinates are in EPSG:4326</p> <p>If &lt;georss:polygon&gt; will also be provided if it is available in data provider’s metadata.</p>
temporal element	<p>For each granule, a single &lt;dc:date&gt; element will be provided to represent the temporal extent of granule.</p> <p>e.g. 1989-10-19T00:00:00.000Z/1989-10-21T23:59:59.000Z</p>
atom: link	<p>Supported values under ‘rel’ attribute: via/enclosure/alternate/icon</p> <p>Detailed information refers to Table 5</p>
atom: summary	<p>Summary descriptive text for the granule</p>

Table 4 Table of Atom <entry> element

**‘rel’ attributes under ATOM <link> element**

‘rel’ attribute	Artifact
via	Metadata
icon	Browse
alternate	Documentation
enclosure	Product

Table 5 Table of ‘rel’ attributes

**5.4. Error Handling**

The CEOS OpenSearch Best Practices (CEOS-BP-017) recommends the use of HTTP status codes as following, 4xx for client errors, and 5xx for server errors.

- 400 Bad Request: The request has an invalid syntax (i.e. badly formatted geometry)
- 413 Request Entity Too Large: The request originates too many returnable hits
- 415 Unsupported media type: Media type in the request is not available or valid.
- 500 Internal Server Error: Default code for the server side for an execution error.
- 501 Not Implemented: When requesting an unimplemented feature (e.g. relation operator not supported).
- 503 Service Unavailable: When the search service is temporarily not available (due to overload or other reasons).
- 504 Gateway Timeout: When the search engine is a broker or aggregator to other services that fail to produce an answer within a giving time frame.

CEOS OpenSearch implementations are recommended to support these codes.

Search timeouts are particularly difficult to identify and manage because they are unpredictable. In many cases, the remote server loses is unable to pass a status code to the client because the connection simply disappears. A best estimate of maximum search times, especially if dependent on search parameters, might be flagged by the remote provider as an error before processing begins, allowing the client to alter the search. Similarly, the underlying search engine or database might simply take too long to build a very large set of results, resulting in the connection from the client timing out. Best practices for handling such unpredictable situations are under discussion by the WDCA System Level team but client developers should be aware of the potential for lost connections and inform the user accordingly.



## 6. Client Partner Implementation Outline

All Connected Data Asset clients are, at their core, just conventional OpenSearch clients with a few extensions and conventions to make the CEOS OpenSearch protocol useful in the WGISS environment. The IDN identifier of the dataset of interest is a mandatory element in CEOS OpenSearch request. Clients could retrieve the dataset ID from the IDN OpenSearch Description Document (OSDD).

This chapter will give brief steps about how to retrieve an IDN dataset ID and how to interact with the granule search server for inventory search. The corresponding details are elaborated in the Use Case chapter.

Data providers will have registered the metadata of their archived datasets into the IDN. The client can query the IDN to retrieve the IDN dataset ID for a desired dataset of interest and, based on that dataset ID and other spatial-temporal query conditions, build a valid CEOS OpenSearch query. The following steps describe the client search scenario starting with IDN OpenSearch.

- 1) Obtain the IDN OpenSearch OSDD to formulate a valid IDN OpenSearch request.

```
https://cmr.earthdata.nasa.gov/opensearch/collections/descriptor_document.xml?clientId=cswOpenSearchDoc
```

Fig. 2 Example of IDN OpenSearch OSDD request

- 2) Search datasets of interest through IDN OpenSearch with proper request parameters (e.g. spatial footprint, temporal extent and keyword).

```
https://cmr.earthdata.nasa.gov/opensearch/collections.atom?keyword=Landsat*&numberOfResults=10&clientId=wgissOpenSearchDoc
```

Fig. 3 Example of IDN OpenSearch request (CWIC collection)

```
https://cmr.earthdata.nasa.gov/opensearch/collections.atom?keyword=CryoSat&numberOfResults=10&clientId=wgissOpenSearchDoc
```

Fig. 6 Example of IDN OpenSearch request (FedEO collection)

- 3) With the IDN OpenSearch response, select the dataset ID for dataset of interest by parsing <dc:identifier> element URI. Obtain the CWIC or FedEO OSDD endpoint for the dataset by parsing the href attribute in <link rel="search">.

```
<feed xmlns="http://www.w3.org/2005/Atom" xmlns:dc="http://purl.org/dc/terms/">  
<entry>
```

```
...
  <dc:identifier>
    http://cwic.wgiss.ceos.org/opensearch/granules.atom/?datasetId=C1235542031-USGS_LTA
  </dc:identifier>
...
  <link
href="http://cwic.wgiss.ceos.org/opensearch/datasets/C1235542031-USGS_LTA/osdd.xml?clientId=cswOpenSearchDoc"
  hreflang="en-US"
  type="application/opensearchdescription+xml"
  rel="search"
  title="CWIC Granule Open Search Descriptor Document"/>
  ...
</entry>
</feed>
```

Fig.4 Example of IDN OpenSearch response

- 4) Based on the retrieved OSDD, formulate an OpenSearch request for granules belonging to that dataset, directed to the relevant server.

```
http://cwic.wgiss.ceos.org/opensearch/granules.atom?datasetId=C1235542031-USGS_LTA&startIndex=1&count=10&timeStart=2000-02-24T00:00:00Z&timeEnd=2014-02-19T00:00:00Z&geoBox=-180,-90,180,90&clientId=cwicClient
```

Fig. 5 Example of CWIC OpenSearch request

## 7. Use Cases (CWIC)

This chapter provides a comprehensive and detailed process about how to implement a WGISS OpenSearch client, which includes how to retrieve the IDN dataset ID for the dataset of interest, and how to build an OpenSearch request.

### 7.1. Retrieve IDN Dataset ID from IDN OpenSearch

Use Case Overview	
Title	Clients start from the IDN OpenSearch
Description	This use case describes steps for retrieving a dataset ID from the IDN OpenSearch.
Actors	OpenSearch client
Initial Status and Preconditions	OpenSearch clients have the IDN OpenSearch access URL.

Table 6 Use Case: Retrieve Dataset ID from IDN OpenSearch

The following steps describe this use case.

Step 1: Obtain IDN OpenSearch OSDD to formulate a valid IDN OpenSearch request.

```
https://cmr.earthdata.nasa.gov/opensearch/collections/descriptor_document.xml?clientId=wgissOpenSearchD
oc
```

Fig. 6 Example of IDN OpenSearch OSDD request

Step 2: Search datasets of interest through IDN OpenSearch with proper request parameters (e.g. spatial footprint, temporal extent and keyword). A complete list of supported request parameters, extracted from the IDN OpenSearch OSDD, is listed as follow:

```
<os:OpenSearchDescription xmlns:os="http://a9.com/-/spec/opensearch/1.1/"
  xmlns:echo="http://www.echo.nasa.gov/esip"
  xmlns:geo="http://a9.com/-/opensearch/extensions/geo/1.0/"
  xmlns:time="http://a9.com/-/opensearch/extensions/time/1.0/"
  xmlns:esipdiscovery="http://commons.esipfed.org/ns/discovery/1.2/" esipdiscovery:version="1.2"
  xmlns:params="http://a9.com/-/spec/opensearch/extensions/parameters/1.0/"
  xmlns:referrer="http://www.opensearch.org/Specifications/OpenSearch/Extensions/Referrer/1.0"
  xmlns:eo="http://a9.com/-/opensearch/extensions/eo/1.0/"
  xmlns:atom="http://www.w3.org/2005/Atom" >
  ...
  <os:Url type="application/atom+xml" rel="collection" params:method="GET"
  template="https://cmr.earthdata.nasa.gov/opensearch/collections.atom?keyword={os:searchTerms?}&in
```

```
strument={echo:instrument?}&satellite={eo:platform?}&boundingBox={geo:box?}&geometry={geo:geometry?}&placeName={geo:name?}&startTime={time:start?}&endTime={time:end?}&cursor={os:startPage?}&numberOfResults={os:count?}&offset={os:startIndex?}&uid={geo:uid?}&hasGranules={echo:hasGranules?}&isCwic={echo:isCwic?}&isGeoss={echo:isGeoss?}&isEosdis={echo:isEosdis?}&clientId=cswOpenSearchDoc">
  <params:Parameter name="keyword" uiDisplay="Search terms" value="{os:searchTerms}"
title="Inventory with terms expressed by these search terms" minimum="0">
  <atom:link rel="profile"
href="http://www.elasticsearch.org/guide/en/elasticsearch/reference/current/query-dsl-query-string-query.html" title="This parameter follows the elastic search free text search implementations"/>
</params:Parameter>
  <params:Parameter name="instrument" uiDisplay="Instrument" value="{echo:instrument}"
title="Inventory associated with a satellite instrument expressed by this short name" minimum="0"/>
  <params:Parameter name="satellite" uiDisplay="Satellite" value="{eo:platform}" title="Inventory
associated with a Satellite/platform expressed by this short name" minimum="0"/>
  <params:Parameter name="boundingBox" uiDisplay="Bounding box" value="{geo:box}"
title="Inventory with a spatial extent overlapping this bounding box" minimum="0"/>
  <params:Parameter name="geometry" uiDisplay="Geometry" value="{geo:geometry}" title="Inventory
with a spatial extent overlapping this geometry" minimum="0">
  <atom:link rel="profile" href="http://www.opengis.net/wkt/LINESTRING" title="This service
accepts WKT LineStrings"/>
  <atom:link rel="profile" href="http://www.opengis.net/wkt/POINT" title="This service accepts
WKT Points"/>
  <atom:link rel="profile" href="http://www.opengis.net/wkt/POLYGON" title="This service accepts
WKT Polygons"/>
</params:Parameter>
  <params:Parameter name="placeName" uiDisplay="Place name" value="{geo:name}" title="Inventory
with a spatial location described by this name" minimum="0"/>
  <params:Parameter name="startTime" uiDisplay="Start time" value="{time:start}" title="Inventory
with a temporal extent containing this start time" minimum="0"/>
  <params:Parameter name="endTime" uiDisplay="End time" value="{time:end}" title="Inventory with a
temporal extent containing this end time" minimum="0"/>
  <params:Parameter name="cursor" uiDisplay="Start page" value="{os:startPage}" title="Start page for
the search result" minimum="0"/>
  <params:Parameter name="numberOfResults" uiDisplay="Number of results" value="{os:count}"
title="Maximum number of records in the search result" minimum="0" maxInclusive="2000"/>
  <params:Parameter name="offset" uiDisplay="Start index" value="{os:startIndex}" title="0-based
offset used to skip the specified number of results in the search result set" minimum="0"/>
  <params:Parameter name="uid" uiDisplay="Unique identifier" value="{geo:uid}" title="Inventory
associated with this unique ID" minimum="0"/>
  <params:Parameter name="hasGranules" uiDisplay="Has granules" value="{echo:hasGranules}"
```

```

title="Inventory with granules">
  <params:Option value="true" label="Yes"/>
  <params:Option value="false" label="No"/>
</params:Parameter>
<params:Parameter name="isCwic" uiDisplay="CWIC collection" value="{echo:isCwic}"
title="Inventory related to CWIC">
  <params:Option value="true" label="Yes"/>
</params:Parameter>
<params:Parameter name="isGeoss" uiDisplay="GEOSS collection" value="{echo:isGeoss}"
title="Inventory related to GEOSS">
  <params:Option value="true" label="Yes"/>
</params:Parameter>
<params:Parameter name="isEosdis" uiDisplay="EOSDIS collection" value="{echo:isEosdis}"
title="Inventory related to EOSDIS">
  <params:Option value="true" label="Yes"/>
</params:Parameter>
<params:Parameter name="clientId" uiDisplay="Client identifier" value="{referrer:source}"
title="Client identifier to be used for metrics" minimum="0"/>
</os:Url>
...
</os:OpenSearchDescription>

```

Fig. 7 Example of supported IDN OpenSearch request parameters

An example request can be formed as follows.

```

https://cmr.earthdata.nasa.gov/opensearch/collections.atom?keyword=Landsat_8&numberOfResults=10&clientId=wgissOpenSearchDoc

```

Step 3: From the IDN CMR OpenSearch response, select the dataset ID for dataset of interest by parsing `<dc:identifier>` element. Obtain CWIC OSDD endpoint for the dataset by parsing the href attribute under `<link rel="search">` element. Note that this data collection happens to be accessed via CWIC.

```

<feed xmlns="http://www.w3.org/2005/Atom" xmlns:dc="http://purl.org/dc/terms/" >
  <entry>
    ...
    <dc:identifier>
      http://cwic.wgiss.ceos.org/opensearch/granules.atom/?datasetId=C1235542031-USGS\_LTA
    </dc:identifier>
    ...
    <link
      href="http://cwic.wgiss.ceos.org/opensearch/datasets/C1235542031-USGS_LTA/osdd.xml?clientId=csw

```

```

OpenSearchDoc"
  hreflang="en-US"
  type="application/opensearchdescription+xml"
  rel="search"
  title="CWIC Granule Open Search Descriptor Document"/>
  ...
</entry>
</feed>
    
```

Fig. 8 Example of IDN OpenSearch Response

## 7.2. Retrieve Granules via OpenSearch

After retrieving the dataset ID by querying through the IDN OpenSearch, OpenSearch clients will sequentially interact with the host remote server for inventory search. The following table shows the basic information about the use case of interacting with WGISS Connected Data Assets via OpenSearch.

Use Case Overview	
Title	Interact with CWIC server for inventory search
Description	This use case describes steps for executing inventory search based on the IDN dataset ID of interest.
Actors	CWIC client
Initial Status and Preconditions	CWC clients have acquired IDN dataset ID. CWIC clients have the CWIC OpenSearch URL.

Table 7 Use Case: Interact with CWIC Server

### Step 1: Obtain the dataset specific OSDD by dataset ID

```

http://cwic.wgiss.ceos.org/opensearch/datasets/C1235542031-USGS_LTA/osdd.xml?clientId=wgissOpenSearchDoc
    
```

Fig. 9 Example of CWIC dataset specific OSDD request

Step 2: Based on the CWIC OSDD, formulate a CWIC OpenSearch request for granules belonging to that dataset.

```

http://cwic.wgiss.ceos.org/opensearch/granules.atom?datasetId=C1235542031-USGS_LTA&startIndex=1&count=10&timeStart=2000-02-24T00:00:00Z&timeEnd=2014-02-19T00:00:00Z&geoBox=-180,-90,180,90&clientId=wgissOpenSearchDoc
    
```

Fig. 10 Example of CWIC OpenSearch request

Step 3: Parse the CWIC OpenSearch response and extract the identifier for the granule of interest from <id> element.

```
<feed xmlns="http://www.w3.org/2005/Atom">
  <entry>
    ...
    <id>http://cwic.wgiss.ceos.org/opensearch/granules.atom?uid=C1235542031-USGS_LTA:Landsat_8:L
C81300472013101LGN01</id>
  </entry>
</feed>
```

Fig. 11 Example of CWIC OpenSearch response

## 8. Use Cases (FedEO)

This chapter provides a comprehensive and detailed process about how to implement a CEOS OpenSearch client, which includes how to retrieve the IDN dataset ID for the dataset of interest, and how to build an OpenSearch request.

### 8.1. Retrieve IDN Dataset ID from IDN OpenSearch

Use Case Overview	
Title	Clients start from the IDN OpenSearch
Description	This use case describes steps for retrieving a dataset ID from the IDN OpenSearch.
Actors	OpenSearch client
Initial Status and Preconditions	OpenSearch clients have the IDN OpenSearch access URL.

Table 8 Use Case: Retrieve Dataset ID from IDN OpenSearch

The following steps describe this use case.

Step 1: Obtain IDN OpenSearch OSDD to formulate a valid IDN OpenSearch request.

```
https://cmr.earthdata.nasa.gov/opensearch/collections/descriptor_document.xml?clientId=wgissOpenSearchDoc
```

Fig. 12 Example of IDN OpenSearch OSDD request

Step 2: Search datasets of interest through IDN OpenSearch with proper request parameters (e.g. spatial footprint, temporal extent and keyword). A complete list of supported request parameters, extracted from the IDN OpenSearch OSDD, is listed as follow:

```
<os:OpenSearchDescription xmlns:os="http://a9.com/-/spec/opensearch/1.1/"
  xmlns:echo="http://www.echo.nasa.gov/esip"
  xmlns:geo="http://a9.com/-/opensearch/extensions/geo/1.0/"
  xmlns:time="http://a9.com/-/opensearch/extensions/time/1.0/"
  xmlns:esipdiscovery="http://commons.esipfed.org/ns/discovery/1.2/" esipdiscovery:version="1.2"
  xmlns:params="http://a9.com/-/spec/opensearch/extensions/parameters/1.0/"
  xmlns:referrer="http://www.opensearch.org/Specifications/OpenSearch/Extensions/Referrer/1.0"
  xmlns:eo="http://a9.com/-/opensearch/extensions/eo/1.0/"
  xmlns:atom="http://www.w3.org/2005/Atom" >
  ...
  <os:Url type="application/atom+xml" rel="collection" params:method="GET"
  template="https://cmr.earthdata.nasa.gov/opensearch/collections.atom?keyword={os:searchTerms?}&in
```



```

strument={echo:instrument?}&satellite={eo:platform?}&boundingBox={geo:box?}&geometry=
y={geo:geometry?}&placeName={geo:name?}&startTime={time:start?}&endTime={time:en
d?}&cursor={os:startPage?}&numberOfResults={os:count?}&offset={os:startIndex?}&
uid={geo:uid?}&hasGranules={echo:hasGranules?}&isCwic={echo:isCwic?}&isGeoss={ech
o:isGeoss?}&isEosdis={echo:isEosdis?}&clientId=cswOpenSearchDoc">
  <params:Parameter name="keyword" uiDisplay="Search terms" value="{os:searchTerms}"
title="Inventory with terms expressed by these search terms" minimum="0">
    <atom:link rel="profile"
href="http://www.elasticsearch.org/guide/en/elasticsearch/reference/current/query-dsl-query-string-query.htm
l" title="This parameter follows the elastic search free text search implementations"/>
  </params:Parameter>
  <params:Parameter name="instrument" uiDisplay="Instrument" value="{echo:instrument}"
title="Inventory associated with a satellite instrument expressed by this short name" minimum="0"/>
  <params:Parameter name="satellite" uiDisplay="Satellite" value="{eo:platform}" title="Inventory
associated with a Satellite/platform expressed by this short name" minimum="0"/>
  <params:Parameter name="boundingBox" uiDisplay="Bounding box" value="{geo:box}"
title="Inventory with a spatial extent overlapping this bounding box" minimum="0"/>
  <params:Parameter name="geometry" uiDisplay="Geometry" value="{geo:geometry}" title="Inventory
with a spatial extent overlapping this geometry" minimum="0">
    <atom:link rel="profile" href="http://www.opengis.net/wkt/LINESTRING" title="This service
accepts WKT LineStrings"/>
    <atom:link rel="profile" href="http://www.opengis.net/wkt/POINT" title="This service accepts
WKT Points"/>
    <atom:link rel="profile" href="http://www.opengis.net/wkt/POLYGON" title="This service accepts
WKT Polygons"/>
  </params:Parameter>
  <params:Parameter name="placeName" uiDisplay="Place name" value="{geo:name}" title="Inventory
with a spatial location described by this name" minimum="0"/>
  <params:Parameter name="startTime" uiDisplay="Start time" value="{time:start}" title="Inventory
with a temporal extent containing this start time" minimum="0"/>
  <params:Parameter name="endTime" uiDisplay="End time" value="{time:end}" title="Inventory with a
temporal extent containing this end time" minimum="0"/>
  <params:Parameter name="cursor" uiDisplay="Start page" value="{os:startPage}" title="Start page for
the search result" minimum="0"/>
  <params:Parameter name="numberOfResults" uiDisplay="Number of results" value="{os:count}"
title="Maximum number of records in the search result" minimum="0" maxInclusive="2000"/>
  <params:Parameter name="offset" uiDisplay="Start index" value="{os:startIndex}" title="0-based
offset used to skip the specified number of results in the search result set" minimum="0"/>
  <params:Parameter name="uid" uiDisplay="Unique identifier" value="{geo:uid}" title="Inventory
associated with this unique ID" minimum="0"/>
  <params:Parameter name="hasGranules" uiDisplay="Has granules" value="{echo:hasGranules}"

```

```

title="Inventory with granules">
  <params:Option value="true" label="Yes"/>
  <params:Option value="false" label="No"/>
</params:Parameter>
<params:Parameter name="isCwic" uiDisplay="CWIC collection" value="{echo:isCwic}"
title="Inventory related to CWIC">
  <params:Option value="true" label="Yes"/>
</params:Parameter>
<params:Parameter name="isGeoss" uiDisplay="GEOSS collection" value="{echo:isGeoss}"
title="Inventory related to GEOSS">
  <params:Option value="true" label="Yes"/>
</params:Parameter>
<params:Parameter name="isEosdis" uiDisplay="EOSDIS collection" value="{echo:isEosdis}"
title="Inventory related to EOSDIS">
  <params:Option value="true" label="Yes"/>
</params:Parameter>
<params:Parameter name="clientId" uiDisplay="Client identifier" value="{referrer:source}"
title="Client identifier to be used for metrics" minimum="0"/>
</os:Url>
...
</os:OpenSearchDescription>

```

Fig. 13 Example of supported IDN OpenSearch request parameters

An example request can be formed as follows.

```

https://cmr.earthdata.nasa.gov/opensearch/collections.atom?keyword= C1532648141-ESA
&numberOfResults=10&clientId=wgissOpenSearchDoc

```

Step 3: From the IDN OpenSearch response, select the dataset ID for dataset of interest by parsing `<dc:identifier>` element. Obtain the OSDD endpoint for the dataset by parsing the href attribute under `<link rel="search">` element. Note that this data collection happens to be accessed via FedEO.

```

<feed xmlns="http://www.w3.org/2005/Atom" xmlns:dc="http://purl.org/dc/terms/" >
  <entry>
    ...
    <dc:identifier>C1532648141-ESA</dc:identifier>
    ...
    <link
href="http://fedeo.esa.int/opensearch/description.xml?parentIdentifier=EOP:ESA:FEDEO:COLLECTIONS:CryoS
at.products"

```

```

hreflang="en-US" type="application/opensearchdescription+xml"
rel="search"
title="Non-CMR OpenSearch Provider Granule Open Search Descriptor Document"/>

...
</entry>
</feed>
    
```

Fig. 14 Example of IDN OpenSearch Response

## 8.2. Retrieve Granules via OpenSearch

After retrieving the dataset ID from the IDN by querying through the CEOS OpenSearch API, OpenSearch clients will sequentially interact with the host remote server for inventory search. The following table shows the basic information about the use case of interacting with FedEO via OpenSearch.

Use Case Overview	
Title	Interact with FedEO server for inventory search
Description	This use case describes steps for executing inventory search based on the IDN dataset ID of interest.
Actors	OpenSearch client
Initial Status and Preconditions	OpenSearch clients have acquired IDN dataset ID. OpenSearch clients have the OpenSearch URL.

Table 9 Use Case: Interact with FedEO Server

Step 1: Obtain the dataset specific OSDD by dataset ID

```

http://fedeo.esa.int/opensearch/description.xml?parentIdentifier=EOP:ESA:FEDEO:COLLECTIONS:CryoSat.products
    
```

Fig. 15 Example of FedEO dataset specific OSDD request

Step 2: Based on the FedEO OSDD, formulate a CEOS OpenSearch request for granules belonging to that dataset.

```

http://fedeo.esa.int/opensearch/request?httpAccept=application%2Fatom%2Bxml&parentIdentifier=CryoSat.products&startRecord=1&maximumRecords=5&startDate=2015-01-01&endDate=2017-12-31&bbox=-180,-90,180,90&clientId=wgissOpenSearchDoc
    
```

Fig. 16 Example of FedEO OpenSearch request

Step 3: Parse the FedEO OpenSearch response and extract the identifier for the granule of interest from <id> element.

```

<feed xmlns="http://www.w3.org/2005/Atom" xmlns:alt11="http://www.opengis.net/alt/2.1"
    
```

```

xmlns:atom="http://www.w3.org/2005/Atom" xmlns:dc="http://purl.org/dc/elements/1.1/"
...
xmlns:time="http://a9.com/-/opensearch/extensions/time/1.0/">
<author>
  <name>FEDEO Clearinghouse</name>
  <email>eohelp@eo.esa.int</email>
</author>
<generator>FEDEO Clearinghouse</generator>
<id>http://fedeo.esa.int/opensearch/request</id>
<rights>Copyright 2016-2018, European Space Agency</rights>
<title>FEDEO Clearinghouse - Search Response</title>
<updated>2018-07-28T17:52:27Z</updated>

...
<entry>

<id>http://fedeo.esa.int/opensearch/request/?httpAccept=application/atom%2Bxml&parentIdentifier=Cr
yoSat.products&uid=CS_OFFL_SIR_SAR_2__20151106T015949_20151106T020006_C001</id>

...
</entry>
...
</feed>

```

Fig. 17 Example of FedEO OpenSearch response

## 9. Abbreviations and Glossary

Term	Maning
AOE	Academy of Optic-Electronic (AOE) of Chinese Academy of Science
CCRS	Canada Centre for Remote Sensing (now CCME0)
CEOS	Committee on Earth Observation Satellites
CLASS	Comprehensive Large Array-data Stewardship System
CSW	OpenGIS Catalog Service for Web
CCME0	Canada Center for Mapping and Earth Observation
CWIC	CEOS WGISS Integrated Catalog
CMR	NASA Common Metadata Repository
CWIC DEV	CWIC development instance
CWIC PROD	CWIC operational instance
CWIC TEST	CWIC public testing instance

---

FedEO	Federated Earth Observation
GCMD	NASA Global Change Master Directory
GHRSSST	Group for High Resolution Sea Surface Temperature
IDN	International Directory Network
INPE	Instituto Nacional de Pesquisas Espaciais (National Institute For Space Research, Brazil)
ISRO	Indian Space Research Organisation
JAXA	Japan Aerospace Exploration Agency
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NRSCC	National Remote Sensing Center of China
OGC	Open Geospatial Consortium
USGS	U.S. Geological Survey
WGISS	Working Group on Information Systems and Services