OpenSearch-based Federated Space-Time Query

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Why So Difficult???

- Example Use Case: fetch all the aerosol-related data for a volcanic ash plume
- Today:
  - Search Google, GCMD, ECHO, and individual data centers, each with its own search tool
  - Query colleagues, etc. for unpublished datasets
- Tomorrow:
  - User makes a single (federated) search for relevant datasets
  - Then a single (federated) space-time query for granules from desired datasets

Version 0 Solution

- Back in the day...
  - Federated dataset query of DAACs
  - Federated space-time query of DAACs for granules
- BUT...
  - Slow
  - Non-standard protocol
  - Expensive to implement individually at each site
- However, these are no longer impediments
  - Speed: fast networks have mitigated this
  - Standards: HTTP, OpenSearch
  - Cost: HTTP/OpenSearch are easy to add as thin layers on top of existing database query engines

Proposed Solution: OpenSearch

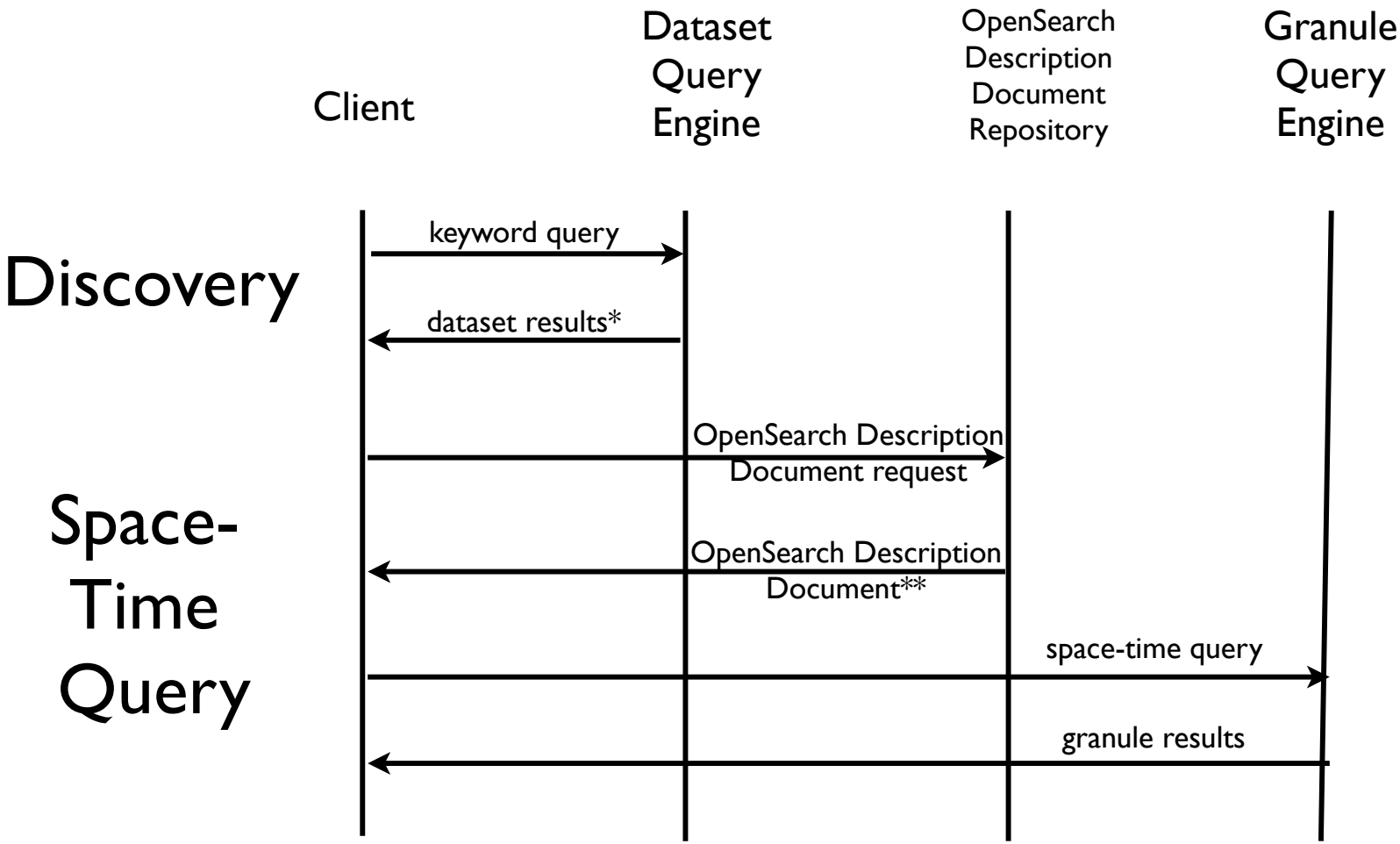
- OpenSearch Description Documents
  - Describe in machine-readable form how to form a URL to execute a query
    - e.g., http://mirador.gsfc.nasa.gov/cgi-bin/mirador/granlist.pl?dataSet=AIRIBRAD.005&page=1&maxgranules=**{count}**&pointLocation=**{geo:box}**&startTime=**{time:start}**&endTime=**{time:end}**&format=atom
  - Allows access to many heritage query servers simply by creating the description document
- Recursive OpenSearch Concept
  - Dataset-level search returns links to OpenSearch Description Documents for granule-level search
- Responses in Atom
  - With additional ESIP conventions (under development)

General sentiment was that "standard" keywords should be recommended but not required. Note that clients will in general still need to parse the template in the OpenSearch Description Document

The Two-Step Query

- Rationale for splitting query into two steps
  - Most dataset-level queries have
    - low "precision": precision = desiderata / (desiderata + dreck)
    - small results set (dozens)
  - Space-time granule queries *for a given dataset* have*:*
    - large results set (tens of thousands), but
    - high precision
  - Combining the two in one step produces:
    - mammoth results set (dozens * tens of thousands)
    - with low precision
- Therefore, concept is:
  - Step 1: dataset search
  - Step 1.5: user / client selection of datasets
  - Step 2: granule search for selected datasets

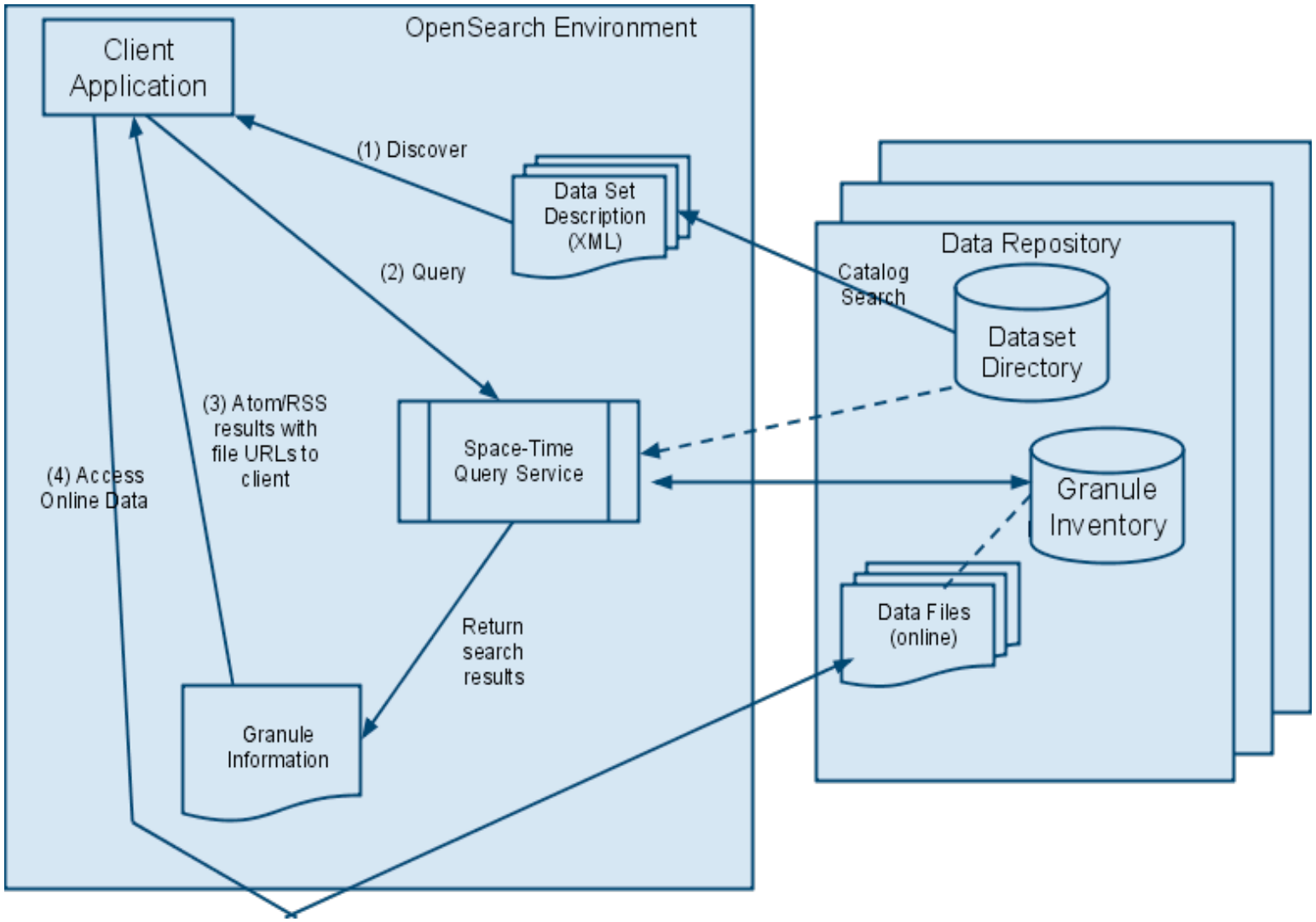
Recursive OpenSearch



*Dataset results include links to OpenSearch Description Documents

**OpenSearch Description Document includes *template* for forming space-time granule queries

OpenSearch Block Diagram



FROST

- Federated - data providers and third parties provide search services
- Recursive - the two-step search
- Open Search - the standard
- Toolset - drop-in server
  + database
  + engine for small data providers and P.I.s

History

- July 1994: Version 0 goes operational
- Oct 2008: "Whatever happened to federated search?"
- Jan 2009: FROST concept proposed at ESIP
- July 2009: FROST demoed at ESIP
- July 2009: Federated Search cluster started in ESIP
- Sept 2009: Federated Search abstract submitted for AGU

What Now?

- Prototype servers in progress
  - GHRC
  - NSIDC
  - ECHO
  - SciFlo nodes
    AQUA ECHO Client
  - MODIS Web Services
  - ACCESS-NEWS
  - Mirador (GES DISC)
  - GCMD (dataset-level)
- ***Resolve ambiguities in Atom responses***
- Prototype clients
  - XSLT: need volunteer(s)
    to make this more robust
  - Mirador
  - Talkoot?
  - Others?

ESIP Conventions for Atom Response

- Spatial Info: georss
  - http://www.opensearch.org/Specifications/OpenSearch/Extensions/Geo/1.0/Draft_1
- Time Info
- Data hyperlinks
- Documentation hyperlinks
- Service hyperlinks
- Connecting dataset results to granule query
- Dataset-level hyperlinks vs. granule-level hyperlinks

Representing Time Information

- Time in the Query
  - Following Draft extension for Time: http://www.opensearch.org/Specifications/OpenSearch/Extensions/Time/1.0/Draft_1
  - http://example.com/?q={searchTerms}&pw={startPage?}&dtstart={time:start}&dtend={time:end}&format=rss
- Time in the Response (Not covered by the extension)
  - Namespace: xmlns:time="http://a9.com/-/opensearch/extensions/time/1.0/"
  - include elements within each item as:
    - <time:start>YYYY-MM-DDTHH:SS:MMZ</time:start>
    - <time:stop>YYYY-MM-DDTHH:SS:MMZ</time:stop>

Representing Data Hyperlinks

- HTML in <atom:content>?
  - but not very parseable or consistent
- XHTML in <atom:content>?
  - more parseable, *but* requires RDFa parsing code
    - hence steep adoption curve
- XHTML in <atom:content> with @type or @title?
  - e.g., <link rel="enclosure" title="Browse" type="image/jpeg"...
  - type has limited expressibility; title should be used for other more readable purposes
- <atom:link> with non-standard "rel" values?
  - e.g., <link rel="http://www.esip.org/fedsearch/browse"...
- <atom:link> elements with additional contents, like machine tags, e.g.:
  - <link rel="enclosure" title="Browse" href="http://disc.gsfc.nasa.gov/daac-bin/airs/displayPreviewImage.py?filename=AIRS.2006.06.10.204.hdf "length="10000" type="image/jpeg">esip:LinkType=Browse</link>
  - But very uncommon; behaviour is undefined in Atom processors

Agreement to use <atom:link> with non-standard "rel" values. Namespace and ontology for those rel values needs to be decided.

Representing Document hyperlinks

- Similar issues to Data hyperlinks
- Insert in granule-level results or just dataset-level results?
- Splitting vs. lumping of different kinds of documents
  - Type as just "datasetDocument" or...
  - User's guides
  - Dataset disclaimers
  - Dataset home page
  - Dataset news feed
  - Dataset OpenSearch Description Document
- Split out "client-actionable" document types?
  - Dataset disclaimer
  - Dataset OpenSearch Description Document

Suggestion that handling of documents not be included in framework. Maybe it should be a separate query?
Counter-proposal to defer until needed by use case, and keep as simple as possible.

Consensus seemed to favor dataset-level, if and when we address documents.

Representing Service Hyperlinks

- Same typing issue as data and documents
- Potential service hyperlinks
  - OPeNDAP
  - OGC
  - Web Services
- Tie to scast conventions?

Connecting Dataset-Level Results to Granule-Level Query

- FROST concept
  - Dataset results includes links to Open Search Description Documents for granule query
    - Need to be tagged as such for machine recognition
    - OSDD template has dataset identifier (whatever it is) "hard-coded"
      - e.g., http://mirador.gsfc.nasa.gov/cgi-bin/mirador/granlist.pl?dataSet=AIRIBRAD.005&page=1&maxgranules={count}&pointLocation={geo:box}&startTime={time:start}&endTime={time:end}&format=atom
- Alternatives using {searchTerms} placeholder?

What's Next

- Testing out the conventions with robust, operational, public clients
  - A robust, common reference client would be helpful...
  - Eventually: Convention / standard validator
- Link to services and servicecasting (scasting)
- Semantic tagging