ESIP Summer Meeting

S2S: Search Service Ontology and Web Application

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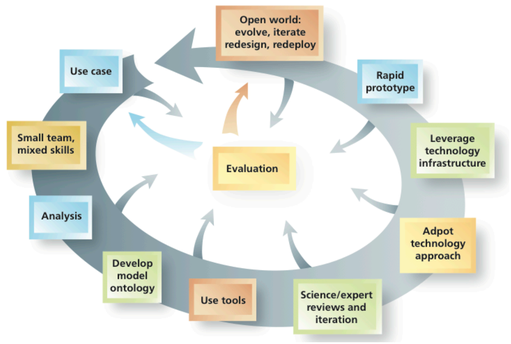
Background:

Oceanographic research covers a broad range of science domains and has had tremendous success in cross-disciplinary endeavors. Advances in cyberinfrastructure are making it easier to share data across disciplines through the use of web services and community vocabularies. Best practices in the design of web services and vocabularies to support interoperability amongst science data repositories are only starting to emerge. Strategic design decisions in these areas are crucial to the creation of end-user data and application integration tools.

We present S2S, a novel framework for deploying customizable user interfaces to support the search and analysis of data from multiple repositories across heterogeneous standards. Our research methods follow the Semantic Web methodology and technology development process developed by Fox et al. The significance of this contribution is the provision of a search service ontology, which provides abstract constructs for describing web services, along with a vocabulary that couples those constructs with abstract user interface definitions.

Semantic Web Methodology & Technology Development Process

- Establish and improve a well-defined methodology vision for semantic technology based on application development
- Leverage controlled vocabularies, etc.



Use Case Name	Oceanography Dept.	Collaborators	Description
Southern Mariana Trough Cruise Preparation	Biology (Larval Ecology)	Stace Beaulieu, Andrew Maffei, Peter Fox	A biologist is preparing an upcoming cruise to study larval ecology at the Southern Mariana Trough. She's interested in CTD data, ocean currents, biogeographic data, and hydrothermal vent information. Ideally, this data can be discovered from a single online resource.
Deployment Data & Metadata Discovery	Geology & Geophysics	Maurice Tivey, Andrew Maffei	Find deployments (e.g., cruises, dives, lowerings) that visited the Vema Fracture Zone and associated metadata including bathymetry instruments, underway data, and occurrences of dredging.
Visual Ocean Profile Finder	Physical Oceanography	Ruth Curry, Andrew Maffei	Determine ocean profile data availability through a visual (e.g., map) interface, allowing restriction of results based on geographic line or area and measured parameters.
Integrating Metagenomics and Ocean Properties	Chemical Oceanography	Mak Saito, Andrew Maffei	Integrate web resources publishing metagenomic data and chemical ocean properties to facilitate the study biological effects on ocean chemistry.

Application Ontology Figure:

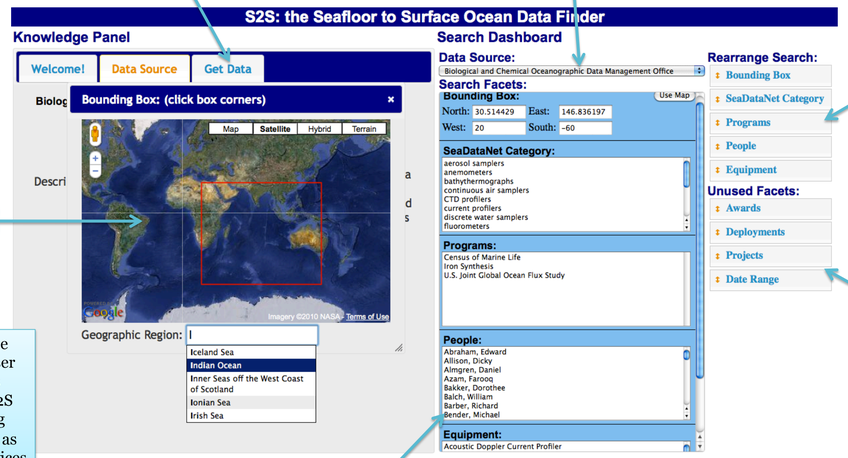
- Visualization created using CMapTools COE.
- Ontology available at http://escience.rpi.edu/ontology/ssf/s2s/2/0/.
- Directed edges represent RDF predicates; rounded nodes represent OWL classes; square nodes represent OWL instances.
- The "are" edges are shorthand for the subclass (subsumption) relationship defined in the RDFS vocabulary; the "is a" edges are shorthand for the type (classification) relationship defined for RDF.

In addition to result widgets, S2S will support parameter description widgets, to provide additional context about a user's parameter restrictions.

Result widgets appear in the Knowledge Panel. The BCO-DMO search service currently supports tabular results (listing available datasets).

Select from available S2S Services for data repositories, which offer search over data resources through semantically-annotated web services

S2S Services do not need to be developed directly by data providers. The open source community can contribute services based on existing data APIs and web services.



The bounding box widget was designed to support multiple inputs:
1) free text input,
2) click and drag in a Google Map,
3) autocomplete search over SeaVoX salt and fresh water body gazetteer

One of the design concepts for the S2S framework was to include user interface definitions as first class citizens. With this separation, S2S Services can easily utilize existing user interface components (such as the bounding box widget for services supporting the geo:box parameter)

Rearrange search parameters for a customized experience. S2S Services can restrict parameter order, for efficiency or other purposes.

Although not strictly a framework for faceted browse, S2S Services can be constructed to meet the requirements of a faceted browser interface.

Search parameters can also be disabled if not needed during a search session.

S2S Services may specify a default configuration for parameters and widgets.

Search widgets are created to facilitate user input, and the available options can be based on other parameter restrictions, enabling faceted search.

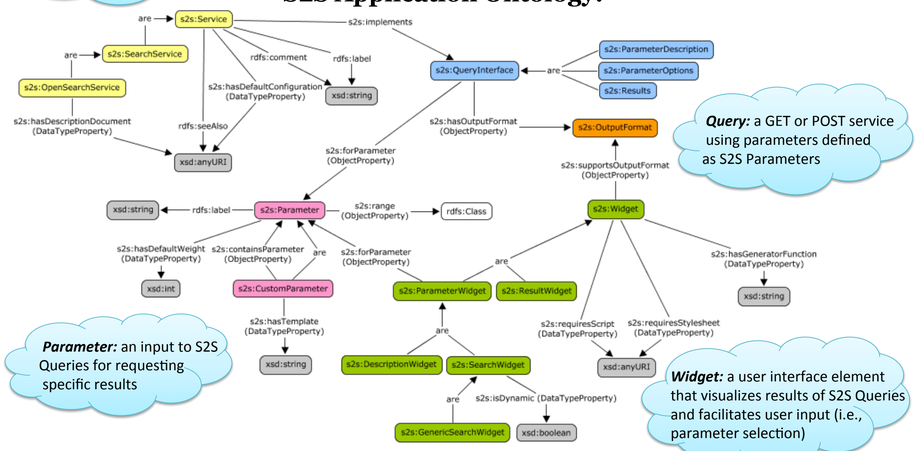
Similar to S2S Services, S2S Widgets can be contributed by the open source community. Many search widgets can be designed for the same parameter, and can rely on web services/resources external from the S2S Service.

Denotes callouts for the S2S GUI prototype.

Denotes additional comments about the S2S framework.

Service: an OpenSearch-described resource that supports S2S Queries

S2S Application Ontology:



Query: a GET or POST service using parameters defined as S2S Parameters

Parameter: an input to S2S Queries for requesting specific results

Widget: a user interface element that visualizes results of S2S Queries and facilitates user input (i.e., parameter selection)

OpenSearch:

- http://www.opensearch.org
- Uses "rel" in Url element to express s2s:QueryInterface
- Uses "template" to relate s2s:Parameter

Example:

<opensearch:Url type="text/html" rel="results" template="http://example.com/search?q={searchTerms?}&pw={geo:box?}" />

SAWSDL:

- Semantic Annotation for WSDL and XML Schema
- Uses sawsdl:modelReference on operation elements to relate s2s:QueryInteface
- Uses modelReference on input elements to relate s2s:Parameter
- Uses modelReference on output elements to relate s2s:OutputFormat

OData:

- http://www.odata.org/
- Use the CSDL specification to encode S2S relations
- Awaiting semantic annotation capability in CSDL

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Glossary:

RPI – Rensselaer Polytechnic Institute
TWC – Tetherless World Constellation at RPI
WHOI – Woods Hole Oceanographic Institution
S2S – Seafloor to Surface Ocean Data Finder
RDF – Resource Description Framework
OWL – Web Ontology Language

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Patrick West and Stephan Zednik from TWC
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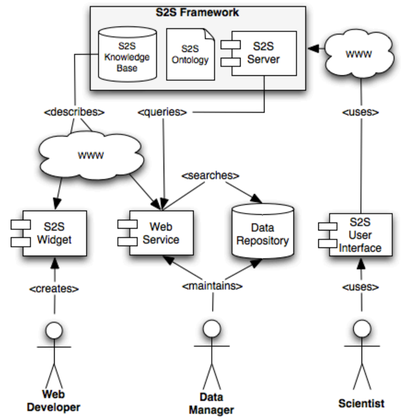
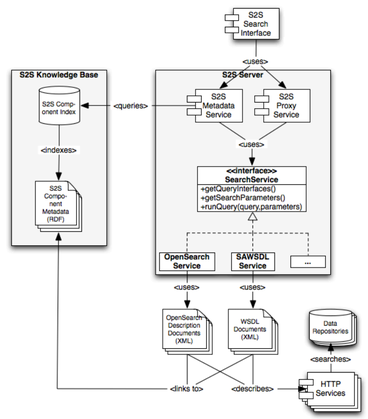
Activity Diagram:



Architecture Diagram:



Future Work and Directions:

- Drupal community website for S2S component registry and search service discovery
- Cross-repository search utilizing community vocabularies
- Data visualization widgets for standard data formats like RDF and NetCDF
- Web browser plug-ins to provide search interfaces at data provider websites