OGC
Open Geospatial Consortium

Geospatial Mediation Update

Ontology Forum
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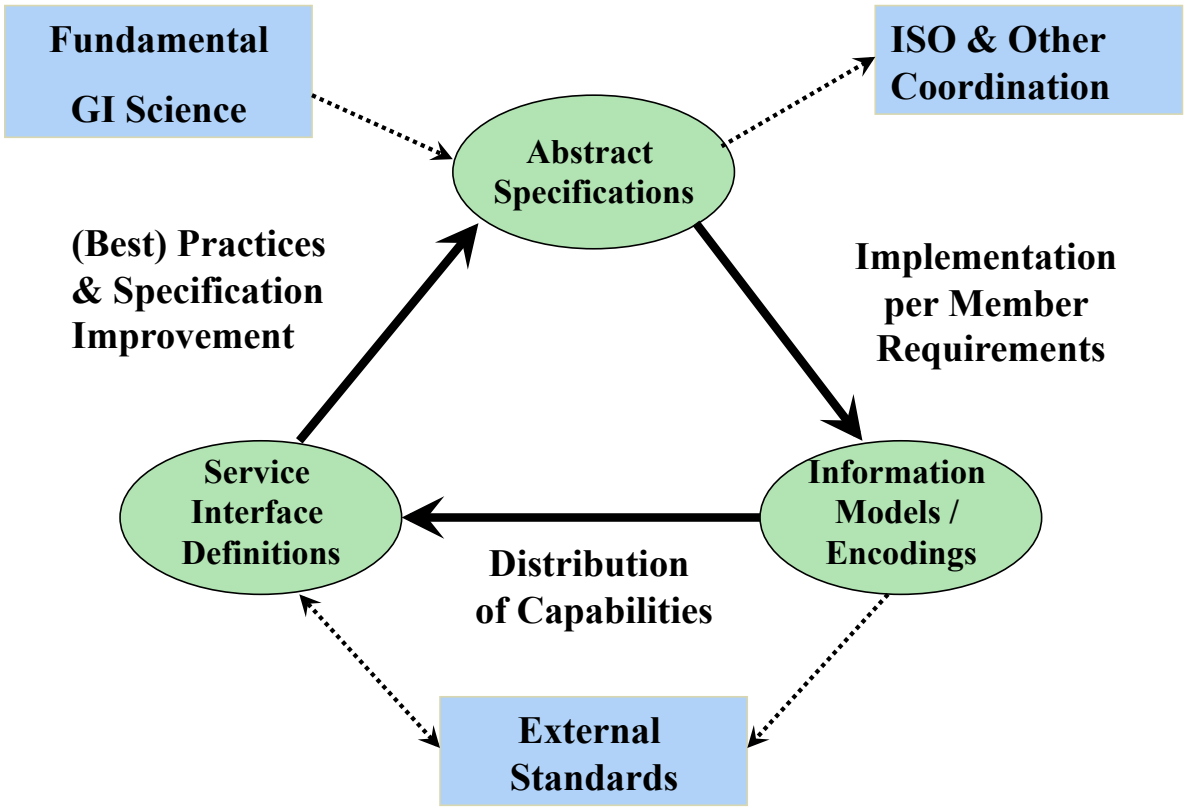
Communique Language

Geospatial Catalog Mediation

* The proposed OGC project would leverage a standards ontologies registry-repository to create and manage mappings between discovery-level models for geospatial information and earth observation resources. Some of these ontologies have been created informally, some have not yet been created for relevant standards. The two use cases would involve first the creation / discovery / management / annotation of ontology artifacts (schema and domain level), and then their data-level use in federated catalogs / knowledgebases for cross-community queries and broad "findability". There is both a general knowledge aspect, and aspects specific to geospatiotemporal observational parameters (feature of interest, phenomenon, measurand, sensor process model, etc.)

OGC Areas of specification



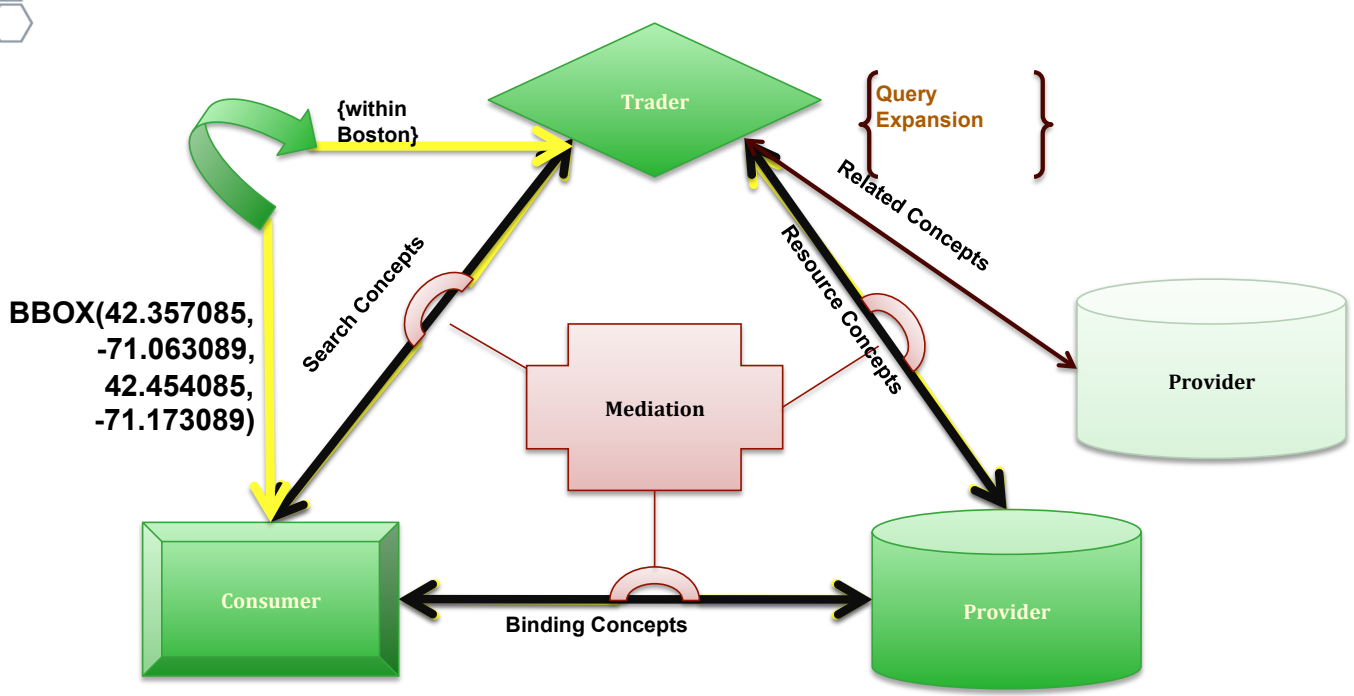
Ideas for Ontology Roles in OGC Standards

- Domain ontologies used in practice for implementation of OGC standards
- OGC implementation specifications which specify ontologies
- OGC abstract or conceptual standards specified using ontologies
- An ontology for the OGC standards process
- Ontologizing lessons for OGC standards process

OGC Encounters with Ontologies

- Geospatial Semantic Web Interoperability Experiment
- W3C Geo 2007 ontology
- Drexel OWL ontologies for OGC / ISO TC211 schemas
- SWING Project semantic annotation
- SWE - Oceans IE Semantic mediation between coastal atlases
- Semantic Annotation Update
- Semantic Enablement Layer
- OWL Profile of Catalog Service for the Web
- Geospatial SPARQL
- IP3 EO Mediator

Geosemantic Roles Within GeoWeb



- Mediation (translation) between community concepts
- Query expansion to add additional concepts
- Inference simplification (e.g. coordinate -> topology) to support reasoning

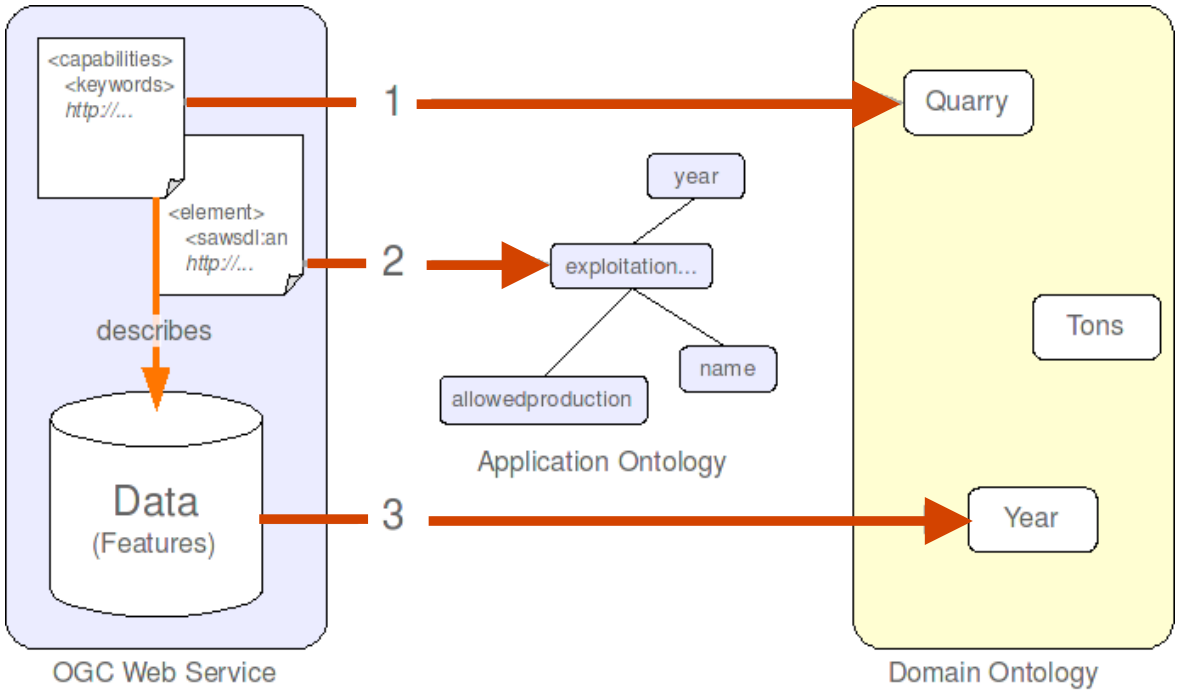
Geosemantic Web Challenges

- Geosemantic agent architecture is under-developed and un-proven in operational systems (or very well hidden away).
- Ontologies and formal encodings for geospatial knowledge are not yet established (chicken – egg problem)
- Geosemantic knowledge is "hidden" in textual description and syntax specifications (substantial task to extract and make explicit)
- Generalized geospatial inference is hard to design and harder to implement (spatial logic and tedious combinatorics)
- Killer app to drive investment in the Geosemantic Web has not yet been discovered (could it be discovery mediation?)

Semantic Annotations in OGC Standards

- Discussion Paper 08-167 - Patrick Maué, Philippe Duchesne, Sven Schade
- Semantic Web services INteroperability for Geospatial decision making (EU-IST FP6 project (FP6-26514))
- Development of ontology infrastructure to support:
  - Semantic annotation of service capabilities and service contents
  - Support the user in formulating goals
  - Discovery of geographic information and geoprocessing services
  - Specify workflows for service execution
- Annotations at 3 levels
  - Keywords & Thesaurii, e.g. gmd:MD_Keywords
  - Application ontologies, e.g. schema annotation with sa-wsdl
  - Data domain ontologies, e.g. using sa:modelReference
- Implications for a variety of OGC implementation standards

Annotations at three levels - Overview



Duchesne, Maué, Schade, 2009

DP 08-167 Summary

- Need for a modelReference data type
  - to be used to explicitly refer to remote semantic concepts by URI
  - abstracts away the semantic language used to describe the concepts
- DP analyzes of existing specifications and looks at how they can integrate usage of modelReferences
  - (Meta)data representation specifications (Capabilities, ISO19115, GML, KML, ebXML, SensorML, …)
  - Querying specification (OGC filters); impact on WFS or CSW
- Conclusions
  - **Existing standards already provide partial annotation capabilities**

  →The need exists and is acknowledged

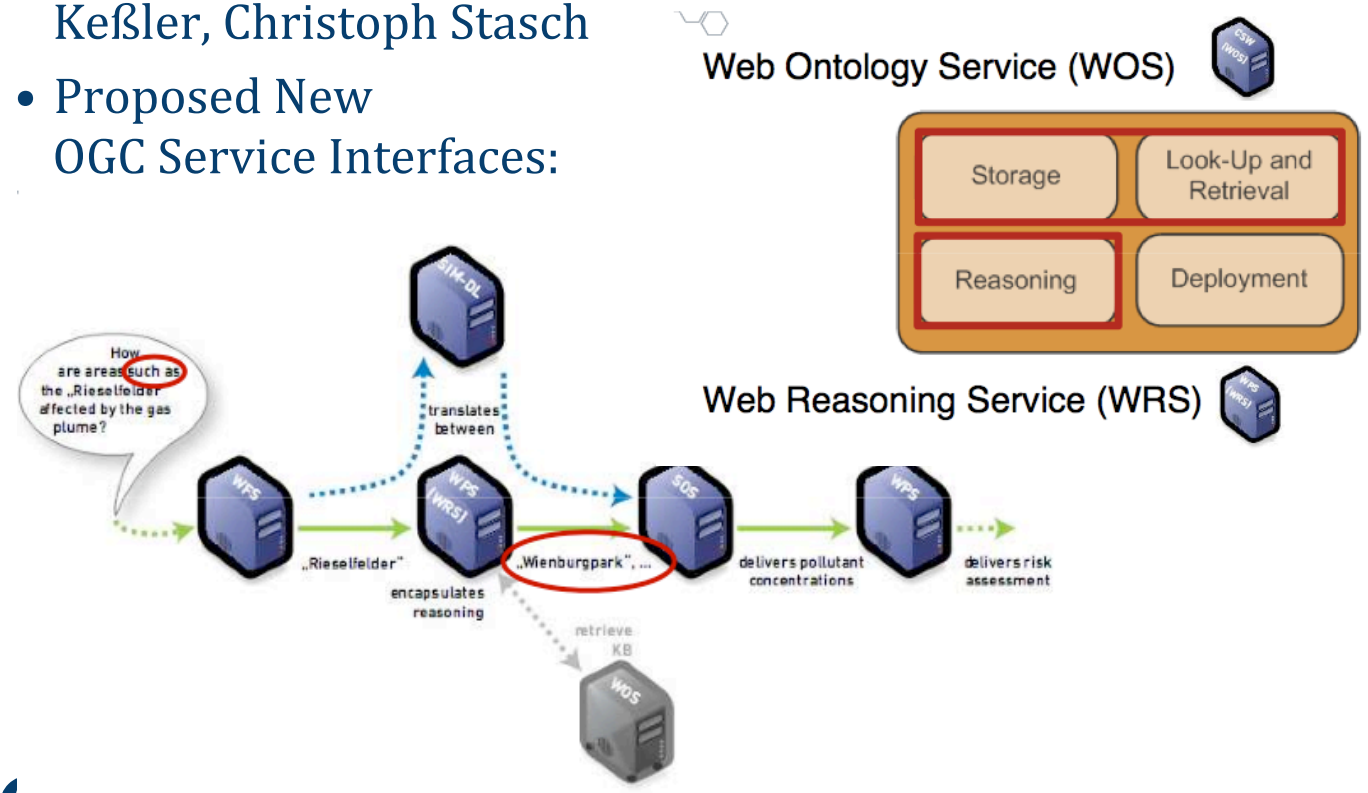
  - **But there's no harmonized solution**

  →define an harmonized way of representing and querying semantic annotations across GIS standards
    - In OWS-Common ?

Duchesne, Maué, Schade, 2009

Semantic Enablement Layer

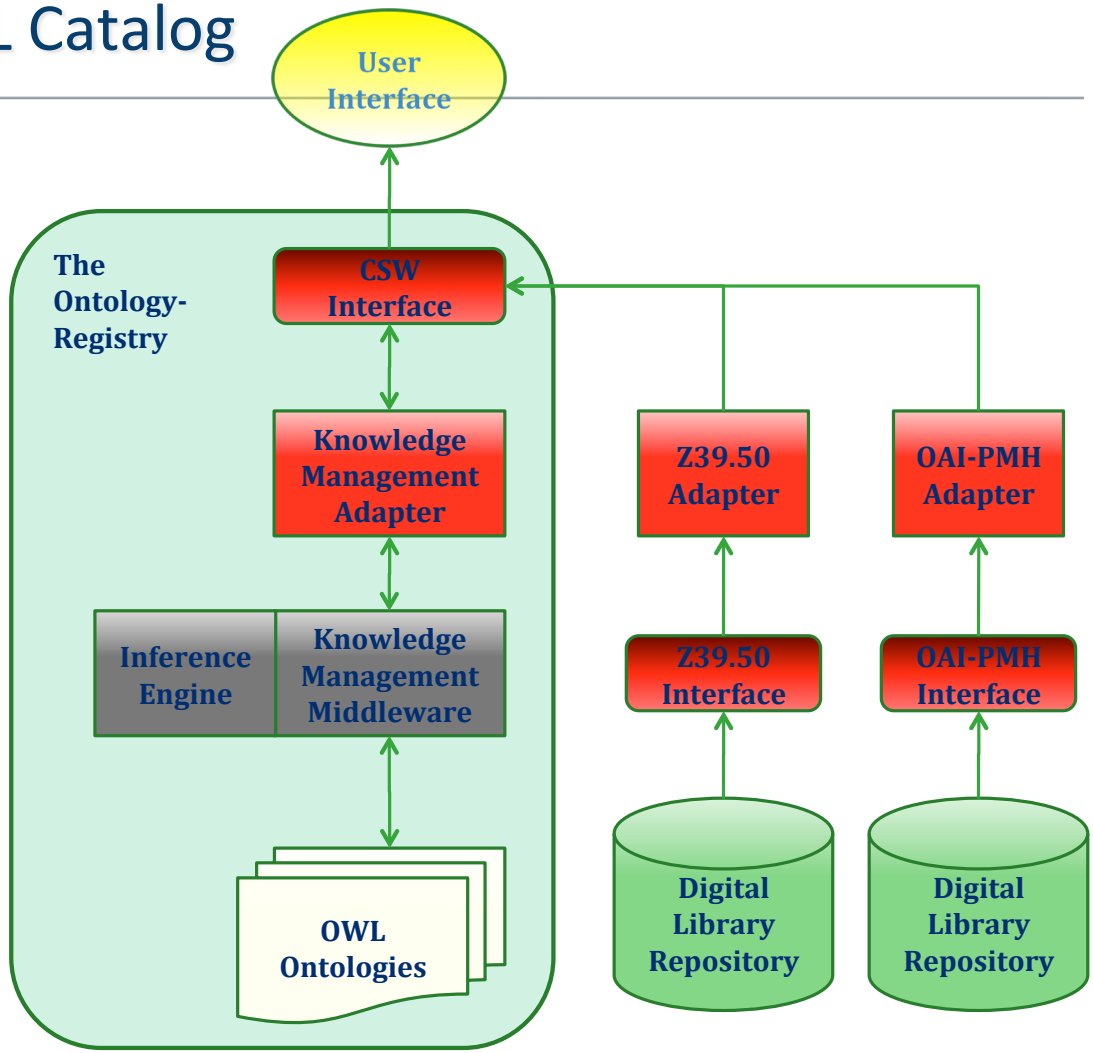
- Krzysztof Janowicz, Sven Schade, Arne Bröring, Carsten Keßler, Christoph Stasch
- Proposed New OGC Service Interfaces:



OWL Catalog

OGC Doc 09-010:
OWL Profile of CSW
Kristin Stock, ed.

App profile includes OWL definition of bounding box.



Expressing Spatial Queries with SPARQL

- Types of spatial properties, operations and relationships
  - Descriptive datatype properties (e.g., dimension)
  - Binary relations (e.g., touches, intersects, contains)
  - Parameterized relations (e.g., within distance)
  - Operations that produce new objects (e.g., buffer, union, intersect)
- SPARQL features to use (rely on *standard* SPARQL 1.0 syntax)
  - Triple patterns
  - Extensible FILTER functions
- Issues
  - What should be in a FILTER clause and what should be in a graph pattern?
  - How do we test relationships with transient spatial objects?
  - What should the arguments be to Spatial FILTER functions?

SPARQL with Spatial Semantics

- Queries involving spatial and non-spatial properties may be expressed using standard SPARQL syntax.
- Graph data model is used to represent simple binary relationships between spatial objects.

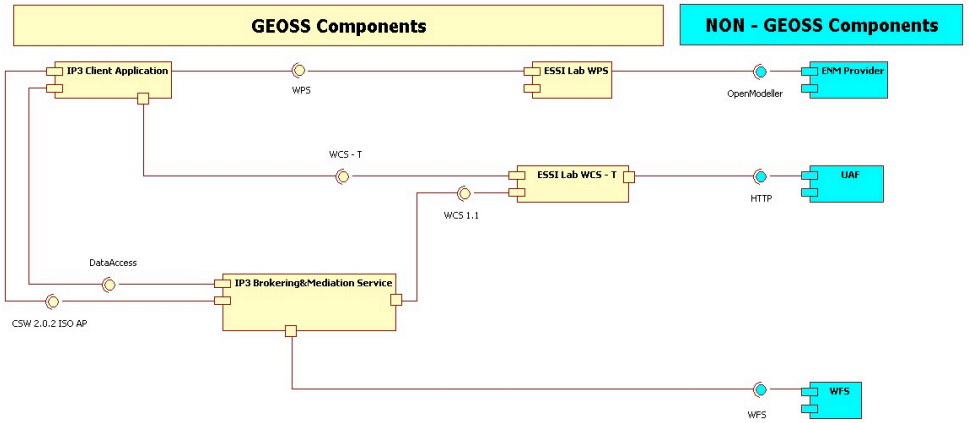
```
:Nashua          ogc:contains     :MineFallsPark
:NewHampshire    ogc:touches      :Massachusetts
:Route95         ogc:crosses      :Route93
:Parcel1         ogc:disjoint     :Parcel2
```

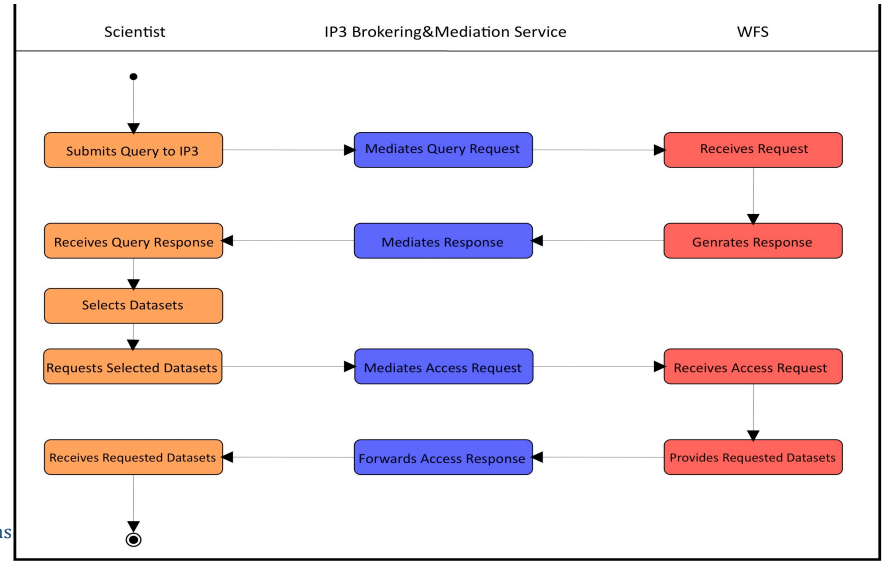
- Simple binary relationships may be tested using triple graph patterns in a SPARQL query.
- Parameterized relationships are tested using a FILTER clause in a SPARQL query.

```
{ :Nashua  ogc:contains  ?park . ?park rdf:type :Park .
  ?park    ogc:hasGML    ?mGML .
  FILTER (ogc:within_distance (?mGML,
            "<gml:..>..</gml:..>"^^ogc:GMLType, 10, "km")) }
```

Service Mediation in GEOSS Pilot

- Architecture Implementation Pilot, phase 2
- Biodiversity and Climate Change Scenario Engineering Report
- S.Nativi and M. Santoro (IMAA – CNR)
- Service mediation role, but not a standard methodology





Next Steps

- Find the proper place for semantics in OGC specifications (overlay, annotation, core)
- Find the proper place for geospatial in ontologies (theory, terminology, appendage)
- Combine mediation role with standard methodology (components and behavior) to drive ontology development (e.g. geospatial SPARQL tools need spatial ontologies)
- Fund a testbed activity to test implementation of both ontologies and mediation components