Data and Service Discovery in Linked SDI and Linked VGI

Virtual Workshop
on Geospatial Semantic Architectures
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Are you ready for the answers?

Agenda

- Introduce Example OGC Workflow
- Describe Analogous Linked Data Workflow:
  - Geographic Feature Types in Linked SDI/VGI
  - Data Discovery with GeoVoID
  - Service Capabilities with GeoSPARQL Service Descriptions
  - SPARQL-based Feature Collections
- Conclusion

Example OGC-based GIS Workflow

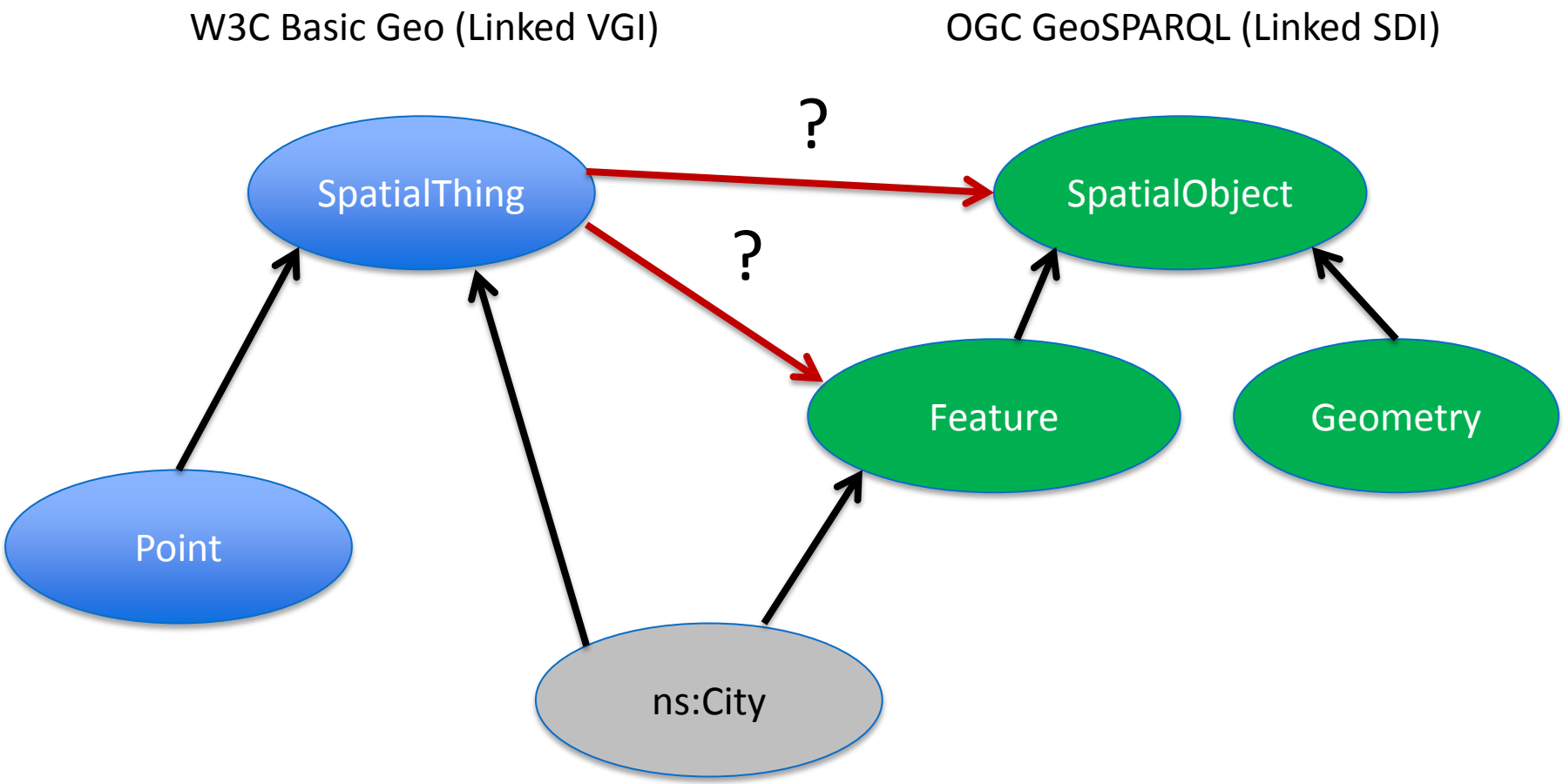
1. Discover OGC Catalog
2. Search Catalog by Feature Type/BBOX
3. Discover OGC WFS Service
4. GetCapabilities
5. GetFeature
6. DescribeFeatureType
7. Add WFS Layer(s) to Map
8. Get Feature By ID

Feature Types in LOD

What constitutes a feature type in Linked Data?

- Linked Data is described using RDFS and OWL ontologies giving data a formal semantics
- Consensus on a "core" *intensional* semantics for geographic phenomena remains elusive
- Option 1: Wait (a long time) for consensus
- Option 2: Minimize ontological commitment and apply definitions driven by *extensional* alignment (i.e. – no core)

Common LOD Feature Type Definitions



Relations = rdfs:subClassOf

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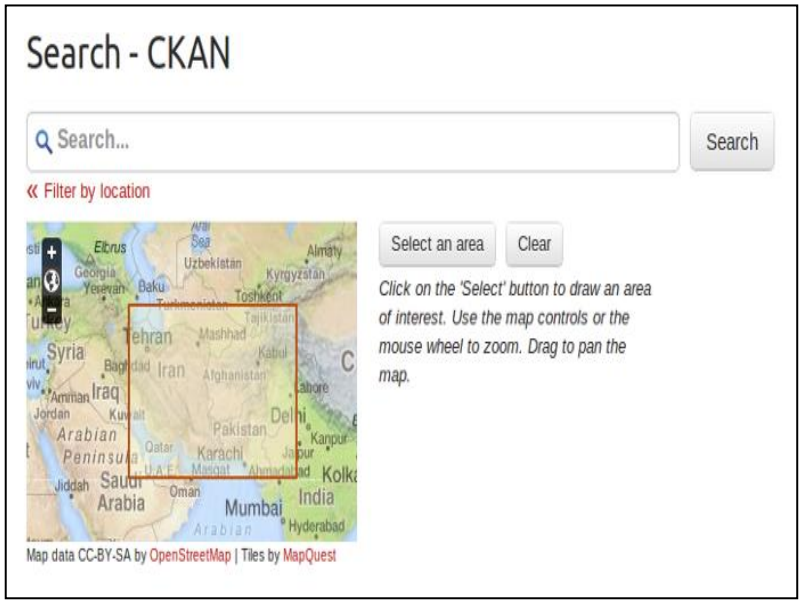
Dataset Discovery with VoID and DCAT

- VoID Capabilities:
  - General metadata
  - Structural
  - Class/property partitions
  - Linksets
- DCAT Capabilities:
  - Interoperability of Catalogs
  - Non-RDF Catalogs



Source: http://docs.ckan.org/en/latest/geospatial.html

- Often stored in data portal like CKAN
  - Offers BBOX dataset queries
  - Has extension support for CSW
- Flexible discovery via centralized catalogs AND socialized links (VoID Repos, URI backlinks, etc.)

Geospatial Data Discovery with GeoVoID

Goals:

- Enable discovery of geographic feature data and services in LOD via:
  - Feature Type Discovery
  - Feature Type Spatial Extents
  - Dataset Spatial Extents
  - Thematic Attribution Schema Discovery (maybe)
  - GeoSPARQL Endpoint Discovery
- Reuse and extend existing LOD vocabs vs. reinvention adding additional heterogeneity
- GeoVoID serves *partially* as a WFS GetCapabilities and DescribeFeatureType for LOD

GeoVoID Methodology

1. Describe datasets using VoID.
2. Then add some geo:

georss:box (geometry)
dc:coverage (placename)
geosparql:rcc8-ntpp (topology)
geovoid:crs

Simple enough?

Example GeoVoID Document Metadata

```
# rdf document metadata
<> a void:DatasetDescription;
    dcterms:title "Test Dataset Description";
    dcterms:description "This is a document containing VoID and
GeoVoID descriptions of an example dataset.";
    dcterms:creator <http://example.org/bob>;
    dcterms:created "04-01-2011"^^<xsd:date>;
    # dublin core to assert spatial coverage of dataset
    dcterms:coverage <http://example.org/the_earth>;
    foaf:primaryTopic <http://example.org/ds1>;
    foaf:topic <http://example.org/ds2>;
    # bounding box of dataset
    georss:box “-180 -90, 180 90”;
    .
```

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GeoVoID Access & Structural Metadata

```
# access metadata; No need to redefine a “GeoSPARQL” endpoint
void:sparqlEndpoint <http://example.org/ds1/sparql/url>;
# structural metadata
# can deref to get representative schema info for geo datasets
void:exampleResource <http://example.org/ds1/example/resource1>;
void:exampleResource <http://example.org/ds1/example/resource2>;
# can discover geovocabs used in geo datasets
void:vocabulary <http://example.org/vocab1>;
void:vocabulary <http://example.org/vocab2>;
# a subset combined with a spatial extent = spatial partition
void:subset <http://example.org/ds1/part1>;
void:subset <http://example.org/ds1/part2>;
# number of geo features in geo dataset
void:entities 33123;
void:triples 10500444;
```

GeoVoID Class & Property Partitions

```
void:classPartition [
    void:class <http://example.org/ont#Road>; # Road = Feature Type
    void:entities 95;   # Number of Road features
    # schema partitions for Road feature type
    void:propertyPartition [ void:property ogc:disjoint; ];
    void:propertyPartition [ void:property rdfs:label; ];
    # geographic feature type partitions can have geospatial extents
    georss:box “-180 -90, 180 90”;
    geosparql:rcc8-ntpp <http://example.org/the_whole_wide_world>;
    # geometry partitions for Road feature type
    void:classPartition [
        void:class <http://www.opengis.net/rdf#LineString>;
        void:entities 95; ];
    void:classPartition [
        void:class <http://www.opengis.net/rdf#Polygon>;
        void:entities 29; ]; ];
```

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SPARQL Service Descriptions

- SPARQL Service Description is a vocabulary for describing features of a SPARQL service
  - Endpoint URIs
  - Supported formats
  - Entailment regimes
- GeoSPARQL Service Descriptions could help describe the capabilities of a given GeoSPARQL endpoint (analogous to GetCapabilities for WFS)
  - Spatial Functions
  - Logical Operators, etc.

GeoSPARQL Service Description

```
[] a sd:Service ;
        sd:endpoint <http://example.org/geosparql/> ;
        sd:supportedLanguage sd:SPARQL11Query ;
        # assert geosparql as supported language
        sd:supportedLanguage gsd:GeoSPARQLQuery ;
        # assert RDF and GIS formats supported
        sd:resultFormat <http://www.w3.org/ns/formats/GeoJSON>,
        <http://www.w3.org/ns/formats/Turtle> ;
        # assert spatial functions supported by GeoSPARQL service
        sd:extensionFunction <http://www.opengis.net/def/queryLanguage/OGC-
        GeoSPARQL/1.0/function/buffer> ;
        sd:feature sd:DereferencesURIs ;
        sd:defaultEntailmentRegime ent:RDFS ;
        # define spatial functions
        <http://www.opengis.net/def/queryLanguage/OGC-
        GeoSPARQL/1.0/function/buffer> a sd:Function .
```

SPARQL-based Feature Collections

- OGC WFS GetFeature returns Feature Collections
- SPARQL SELECT “Feature Collections”:
  - Each *Query Solution* represents a feature
  - *Query Solution* “may” contain bound geometry variable
  - *Solution Sequence* represents a Feature Collection
- SPARQL CONSTRUCT “Feature Collections”:
  - Features in returned RDF can be asserted or inferred
  - Geometry may be part of a *Query Solution*
  - *Solution Sequence* represents a Feature Collection
- SPARQL-based FeatureCollection Envelopes?
- Geometry can also be dereferenced and features co-referenced which yields additional capability

Mapping Between OGC and LOD GIS Workflow

OGC

1. Discover Catalog
2. Search Catalog by Feature Type/BBOX
3. Discover WFS Service
4. WFS Get Capabilities
5. WFS GetFeature
6. DescribeFeatureType
7. Add FeatureCollection to Map
8. GetFeatureByID

LOD

1. Discover DCAT or GeoVoID Repo
2. Search Repo by Type/BBOX
3. Get GeoSPARQL Endpoint
4. GeoSPARQL Service Description
5. GeoSPARQL Query
6. VoID partitions + SPARQL Describe + VoID example URI?
7. Add GeoSPARQL Results to Map
8. Dereference URI; Content negotiation for RDF/GIS

Conclusions

To “start” discovering geospatial data, services and feature types in Linked Data we need:

- Alignment axioms for Feature Type definitions
- GeoVoID *methodology* for dataset descriptions
- GeoSPARQL Service Description for service capabilities
- Common Feature Collection representations for SPARQL results
- Future work needs to address *spatiotemporal*

Thanks!

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