

The Data Model stRDF and the Query Language stSPARQL

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Motivation

How do we represent spatial and temporal metadata in the Semantic Web (aka Web of data, Linked data)?

Example:

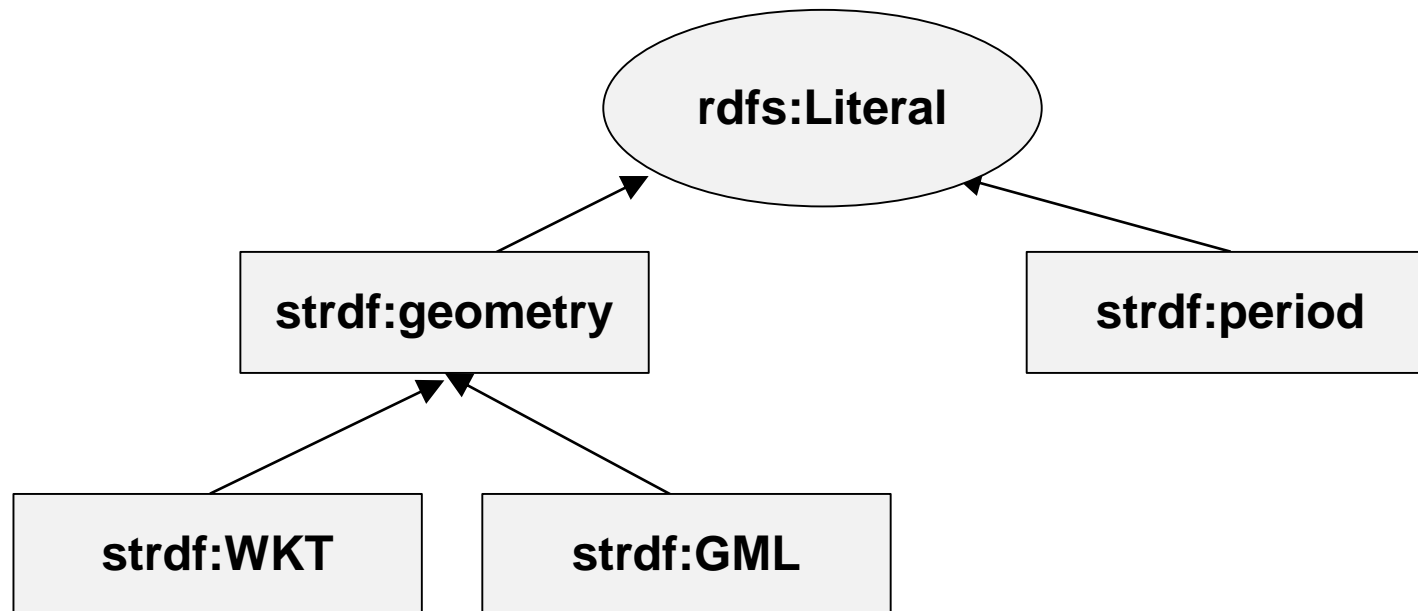
- The vision of the **Semantic Sensor Web**: annotate sensor data and services to enable discovery, integration, interoperability etc. (Sheth et al. 2008, SensorGrid4Env)
- Sensor annotations involve **thematic, spatial** and **temporal** metadata. Examples:
 - The sensor measures temperature. (thematic)
 - The sensor is located in the location represented by point (A, B). (spatial)
 - The sensor measured 30⁰ C on 26/01/2010 at 03:00pm. (temporal)

Motivation

How about using RDF?

Good idea. But RDF can **represent only thematic metadata** properly. What can we do about spatial and temporal metadata?

The stRDF Data Model



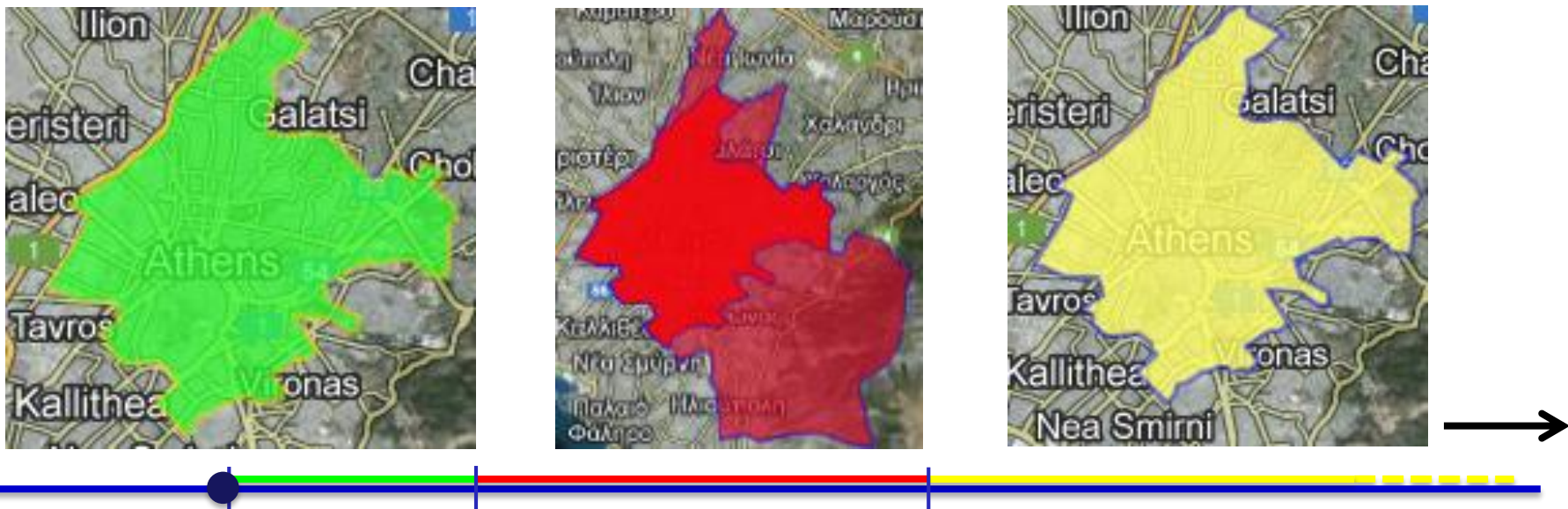
The Data Model stRDF

- **stRDF** stands for **spatial/temporal RDF**.
- It is an extension of the W3C standard RDF for the representation of **geospatial data that may change over time**.
- stRDF extends RDF with:
 - **Spatial literals** encoded in OGC standards Well-Known Text or GML
 - **New datatypes** for spatial literals (`strdf:WKT`, `strdf:GML` and `strdf:geometry`)
 - **Temporal literals** can be either periods or instants
 - **New datatype** for temporal literals (`strdf:period`)
 - Placed as the fourth component of a triple to denote valid time

[ESWC 2010,
ISWC 2012]

[ESWC 2013]

stRDF: An example



```
clc:region1 clc:hasLandCover clc:Forest .  
  "[2006-08-25T11:00:00+02,2007-08-25T11:00:00+02) "^^strdf:period .
```

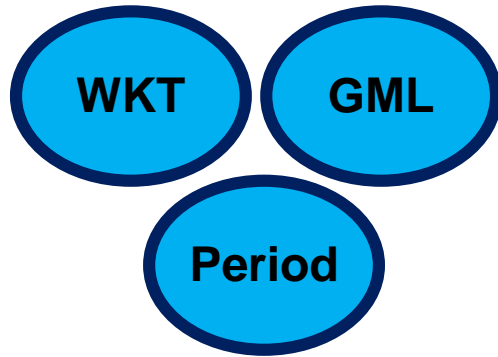
```
noa:ba1 rdf:type noa:BurntArea  
  "[2007-08-25T11:00:00+02,2009-08-25T11:00:00+02) "^^strdf:period .
```

```
clc:region1 clc:hasLandCover clc:AgriculturalArea  
  "[2009-08-25T11:00:00+02, "UC) "^^strdf:period .
```

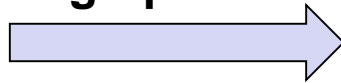

stSPARQL: More details

- We start from **SPARQL 1.1**.
- We add a **SPARQL extension function** for each function defined in the OGC standard **OpenGIS Simple Feature Access – Part 2: SQL option (ISO 19125)** for adding geospatial data to relational DBMSs and SQL.
- We add a set of temporal functions (superset of Allen's functions) as SPARQL extension functions
- **Spatial** and **temporal** predicates can be used in the **SELECT** and **FILTER** clause of a SPARQL query
- Allow quad patterns in the WHERE clause to refer to valid time of a triple

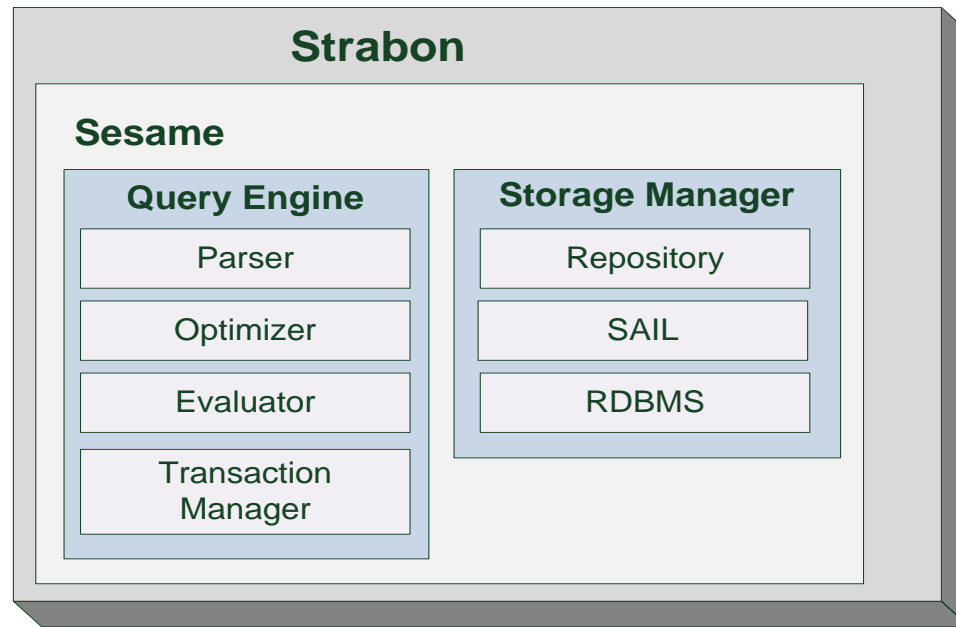
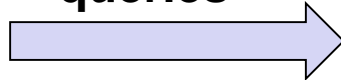
Strabon: A Scalable Geospatial RDF Store



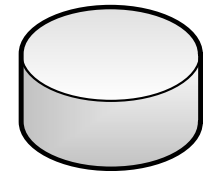
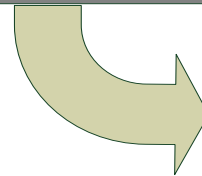
stRDF
graphs



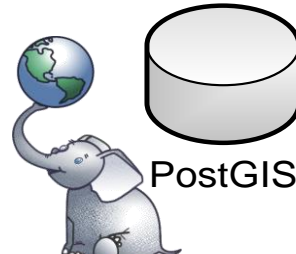
stSPARQL/
GeoSPARQL
queries



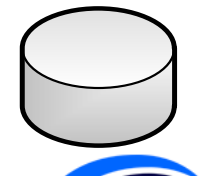
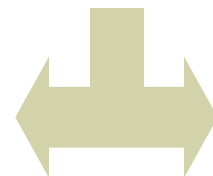
[ISWC 2012,
ESWC 2013]



GeneralDB



PostGIS



monetdb

<http://bit.ly/Strabon>