A Vision for vario-scale reference maps integrated with thematic data

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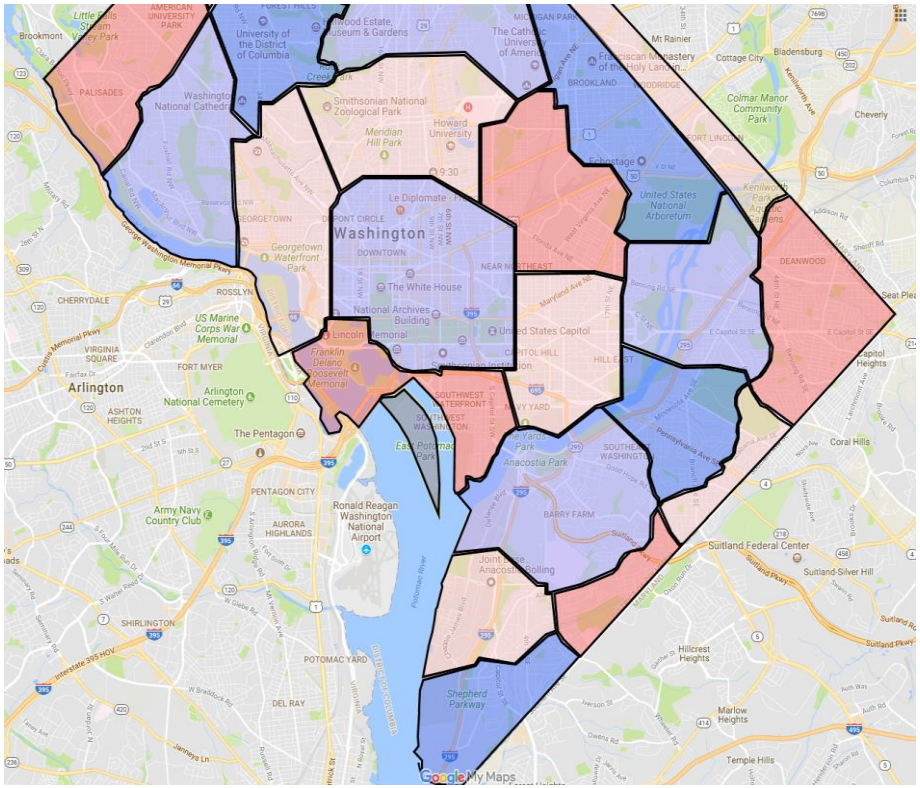
Current map mashups

- Created by simply overlaying thematic layer on a base map
- The levels of detail between thematic layer and base map are barely synchronized and this raises geometric inconsistencies and sometimes confusing for web map users.



Google My Maps mashup: DC taxi zones

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Disposition

1) Data integration for single-scale maps

2) Data integration for multiple representation databases

3) Data integration for vario-scale representation

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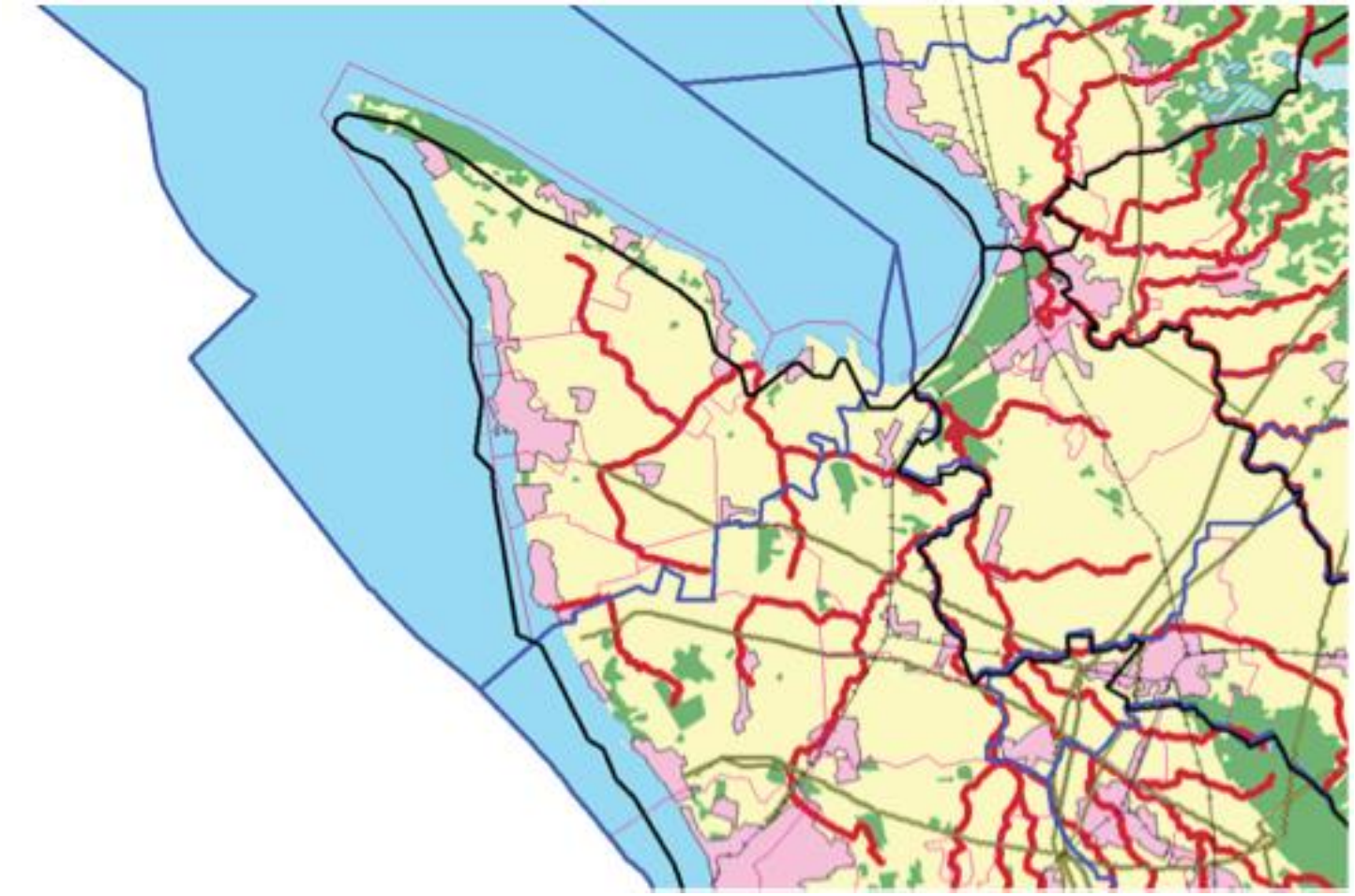
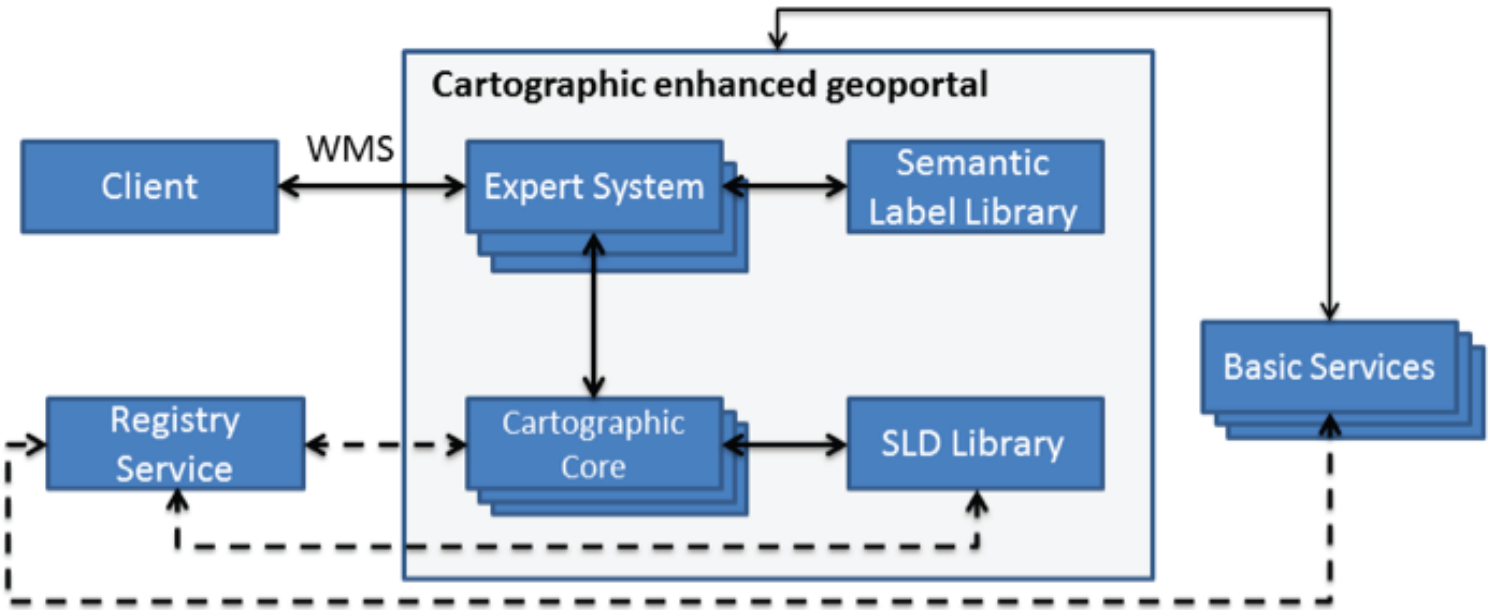
1. Data integration for single-scale maps



TOOMANIAN, A., HARRIE, L., MANSOURIAN, A., and PILESJÖ, P., 2013. Automatic integration of spatial data in viewing services, ***Journal of Spatial Information Science*****, 6:43-58**

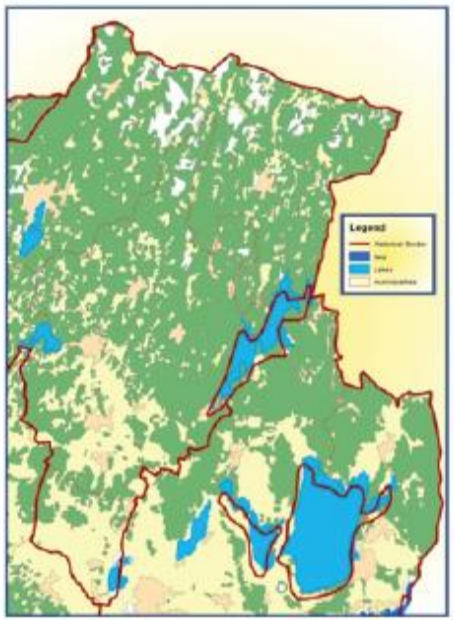
Registration

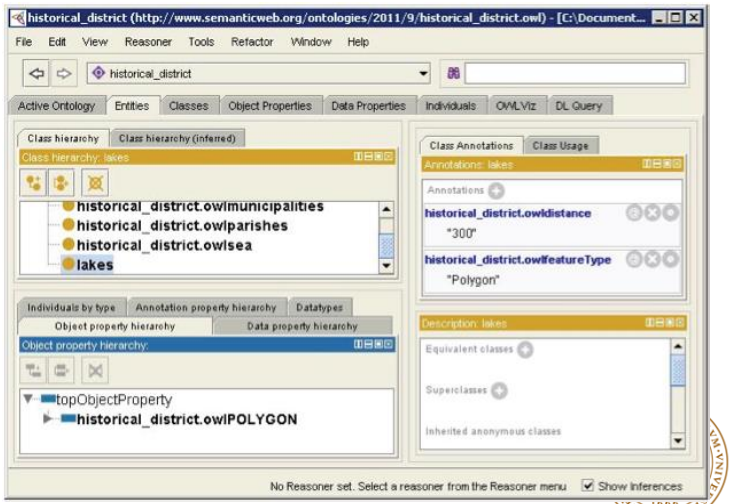
1) **Symolisation (SLD)**
2) **Semantic relation relationships (OWL)**



Example of semantic registration

1	The *historical border* coincides with *sea* shore
2	If the *historical border* area coincides with a *lake* area more than 50% then replace the *historical border* with the *lake* border.
3	The *historical border* replaces *lake* within the distance of 500m or less
4	The *historical border* is replaced by *sea* border if the distance is 500m or less
5	The *historical border* is replaced by *municipality* border if the distance is 500m or less
6	The *historical border* has to be adjusted in the order of *sea, lake,* and *municipality.*
7	The *historical border* cannot be on top of a *sea* layer
8	The *historical border* can be on top of a *lake*





Prot´eg´e software

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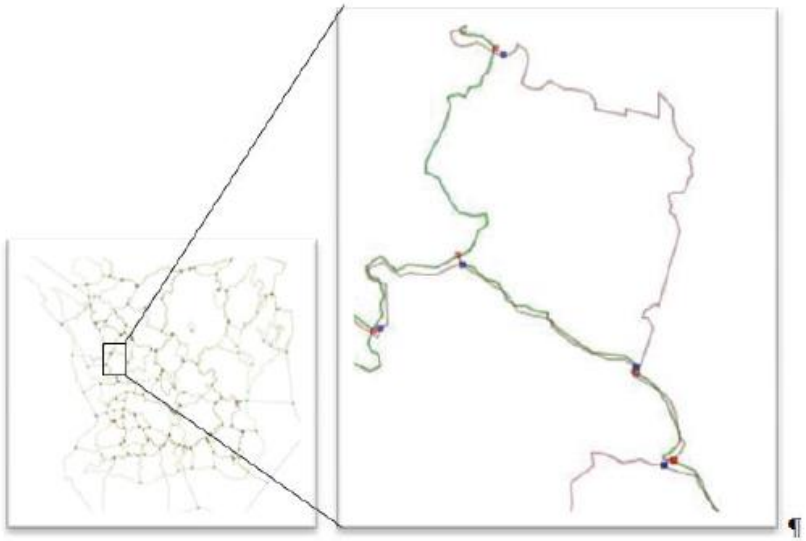
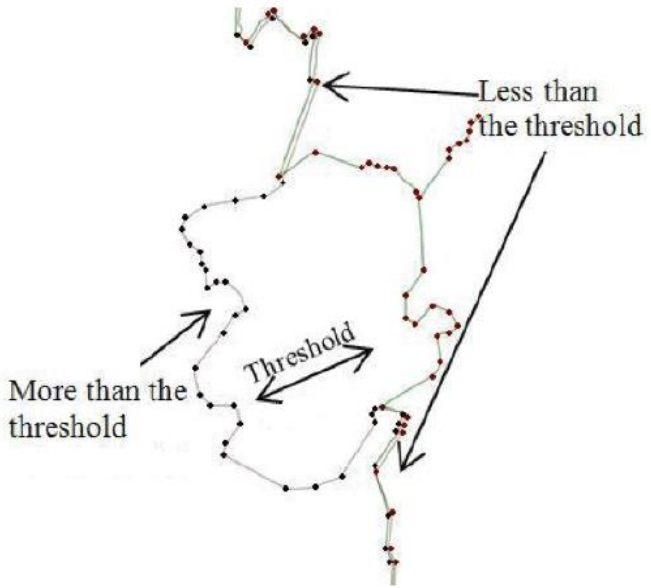
Geometric conflation method



1) Create a network of the data that is semantically related to the thematic data

2) Finding corresponding nodes

3) Create new geometries for the thematic data based on the base map and new data.



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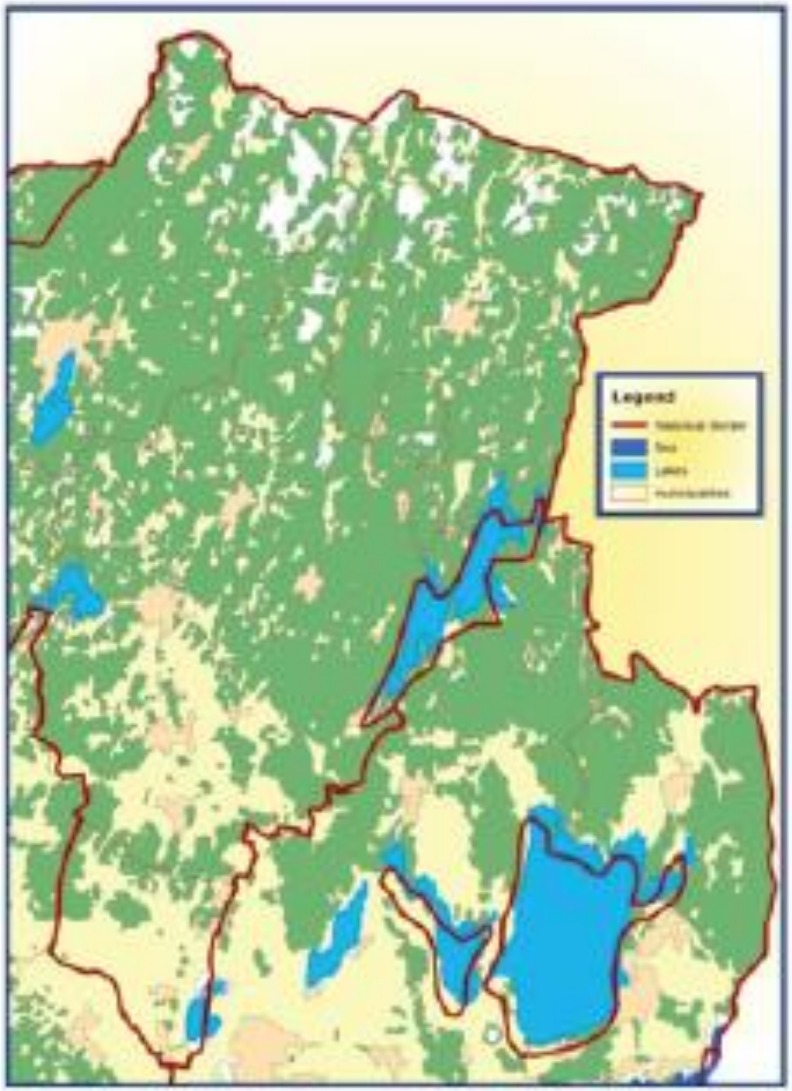

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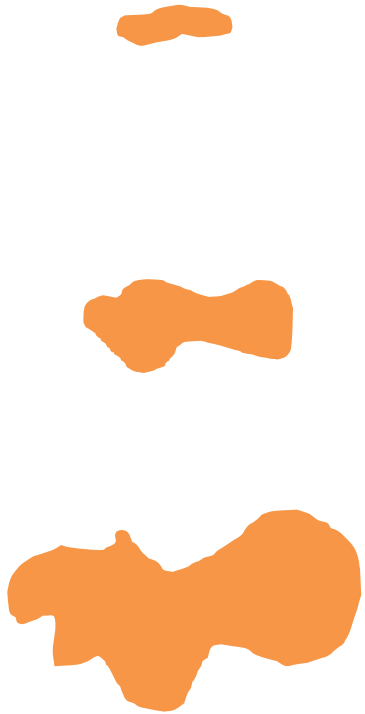
2. Data integration for multiple representation databases

Reference map

Scale



Thematic data

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Thematic data expressed using relative positioning

- Relative positioning utilizes features in the reference map
- Relative positioning is widely employed in BIM

Sillmansåsen from Lantmäteriet (© Lantmäteriet, Dnr: I2014/00579)

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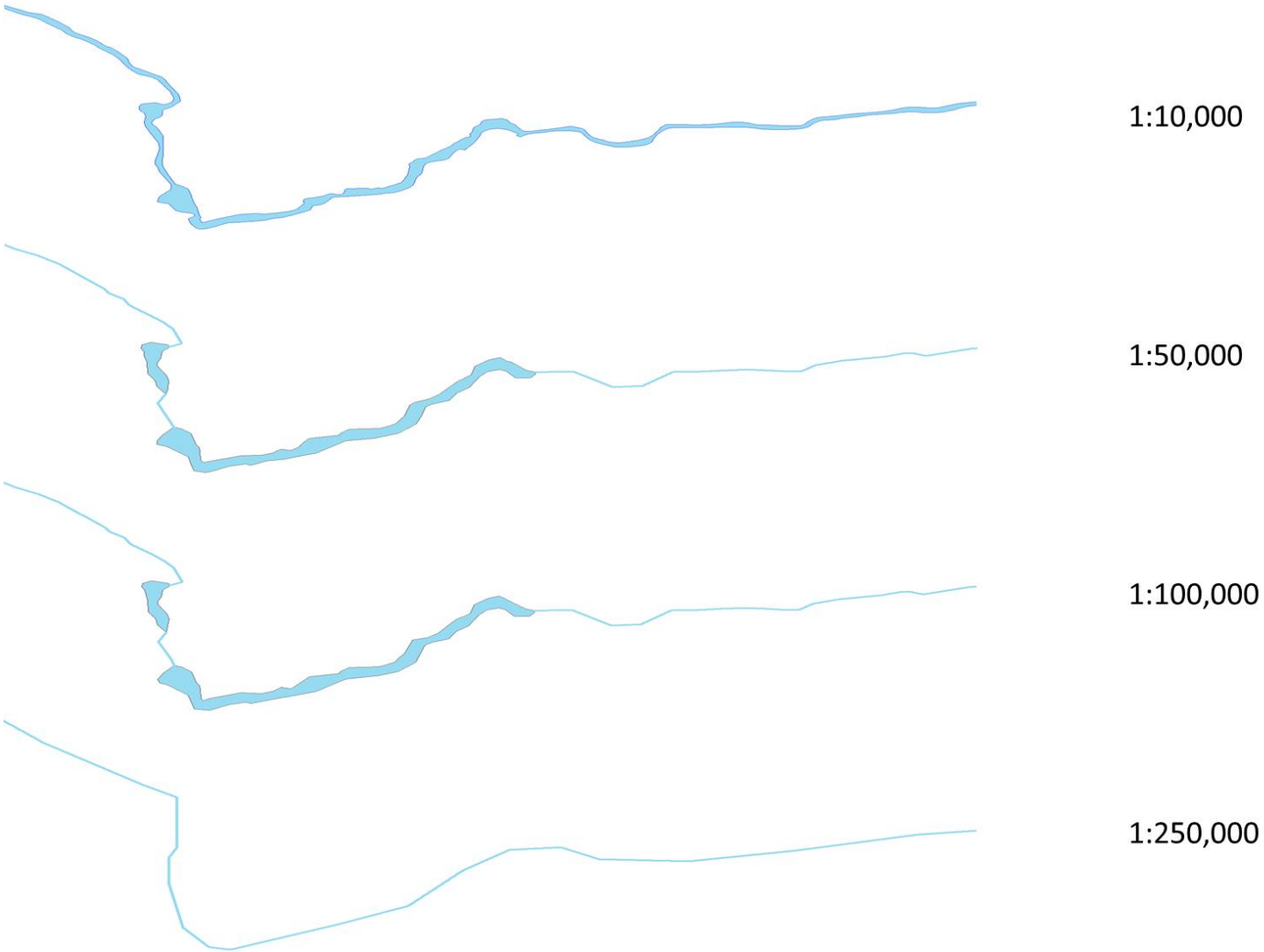
Unique object identifiers link objects through scales



Utilizing a linked data approach

- The application linked data has developed considerably lately.
- NMAs are investigating the potential of linked data and some of them have started releasing authoritative geodata as linked open data.
- Linked data are organized as triples:

  subject, predicate, object

where subjects/objects often are URIs

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Base maps distributed as linked data

Ordnance Survey

You are here: linked-data

Ordnance Survey Linked Data Platform

Quick Search: Enter a place name or postcode to view as

Ordnance Survey is Great Britain's national mapping agency, providing the most accurate and up-to-date geographic data, relied on by government, business and individuals.

OS OpenData is the opening up of Ordnance Survey data as part of the drive to increase innovation and support the "Making Public Data Public" initiative. As part of this initiative Ordnance Survey has published a number of its products as Linked Data. Linked Data is a growing part of the Web where data is published on the Web and then linked to other published data in much the same way that web pages are interlinked using hypertext.

The term Linked Data is used to describe a method of exposing, sharing, and connecting data via URIs on the Web. To find more Linked Data published as part of this initiative please go to data.gov.uk.

If you are not familiar with Linked Data, OS OpenData products are also available in alternative formats from the OS OpenData website. Ordnance Survey can provide support for the Ordnance Survey OpenData products, but cannot give advice or support on using RDF, SPARQL or SPARQL Endpoints.

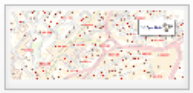
Ordnance Survey has published three OS Open Data products as Linked Data: the 1:50 000 Scale Gazetteer, Code-Point Open and the administrative geography for Great Britain taken from Boundary Line. A combined OS Linked Data dataset combines these products into one database to support more flexible data access.

Each of the datasets is accessible as Linked Data and via a range of APIs.

Current Datasets

OS OpenData

Ordnance Survey Linked Data
58,233,148 triples



Code-Point Open Linked Data
33,892,896 triples

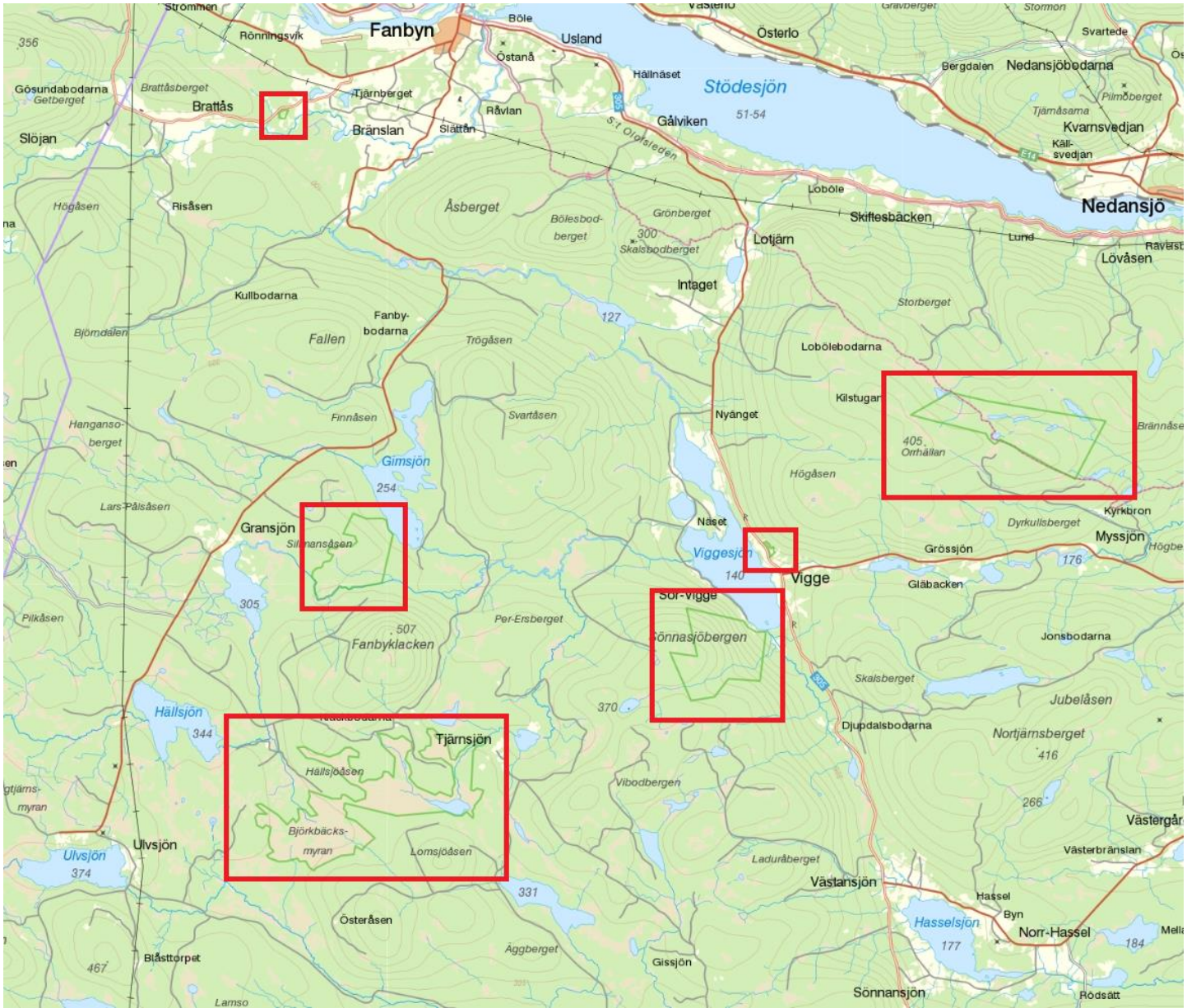
Open Names Linked Data
21,276,861 triples

50K Gazetteer Linked Data
2,362,412 triples

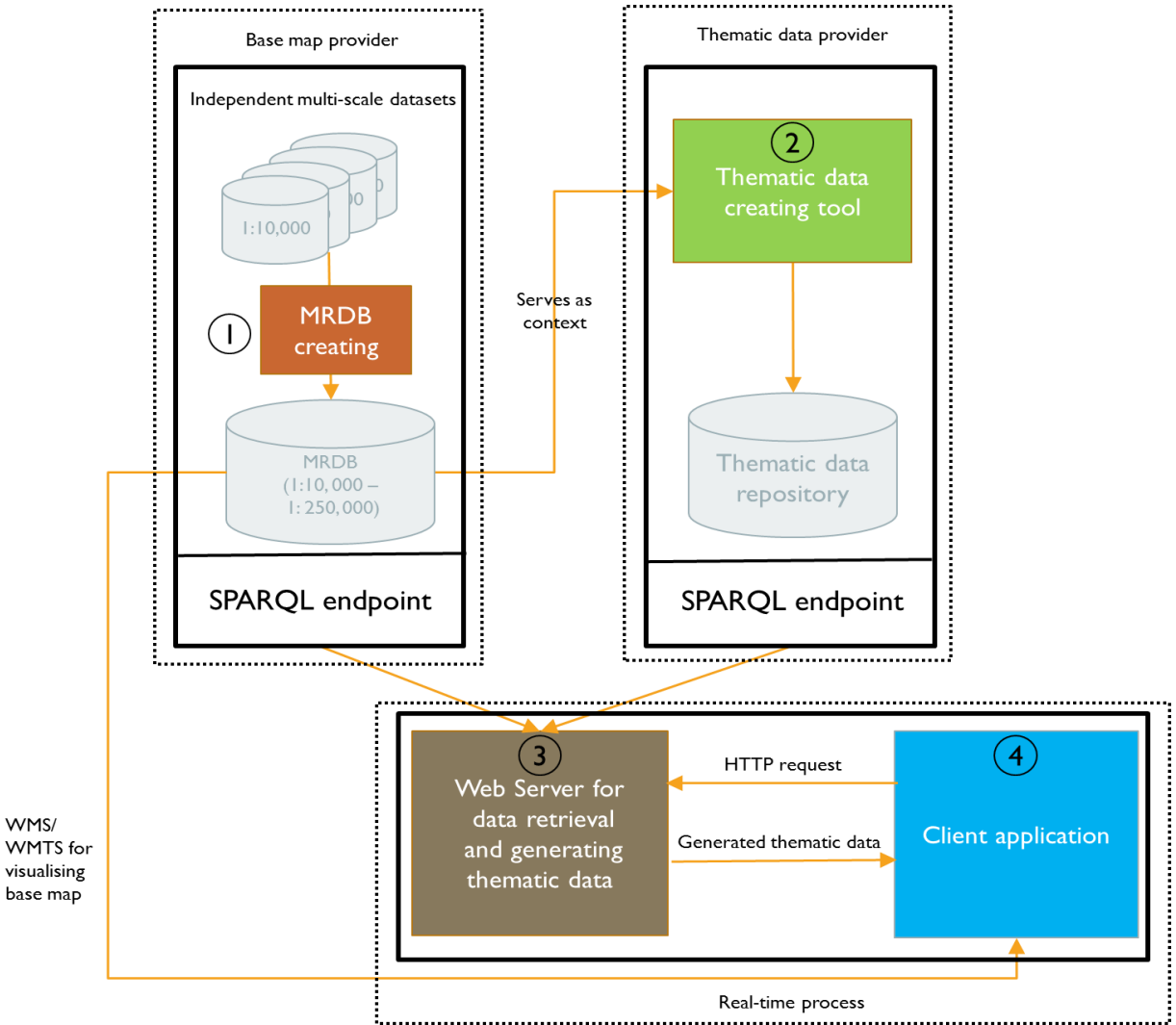
Boundary Line Linked Data
699,499 triples

Case study

Huang et al., 2017. Synchronising Geometric Representations for Map Mashups Using Relative Positioning and Linked Data, under review



System architecture



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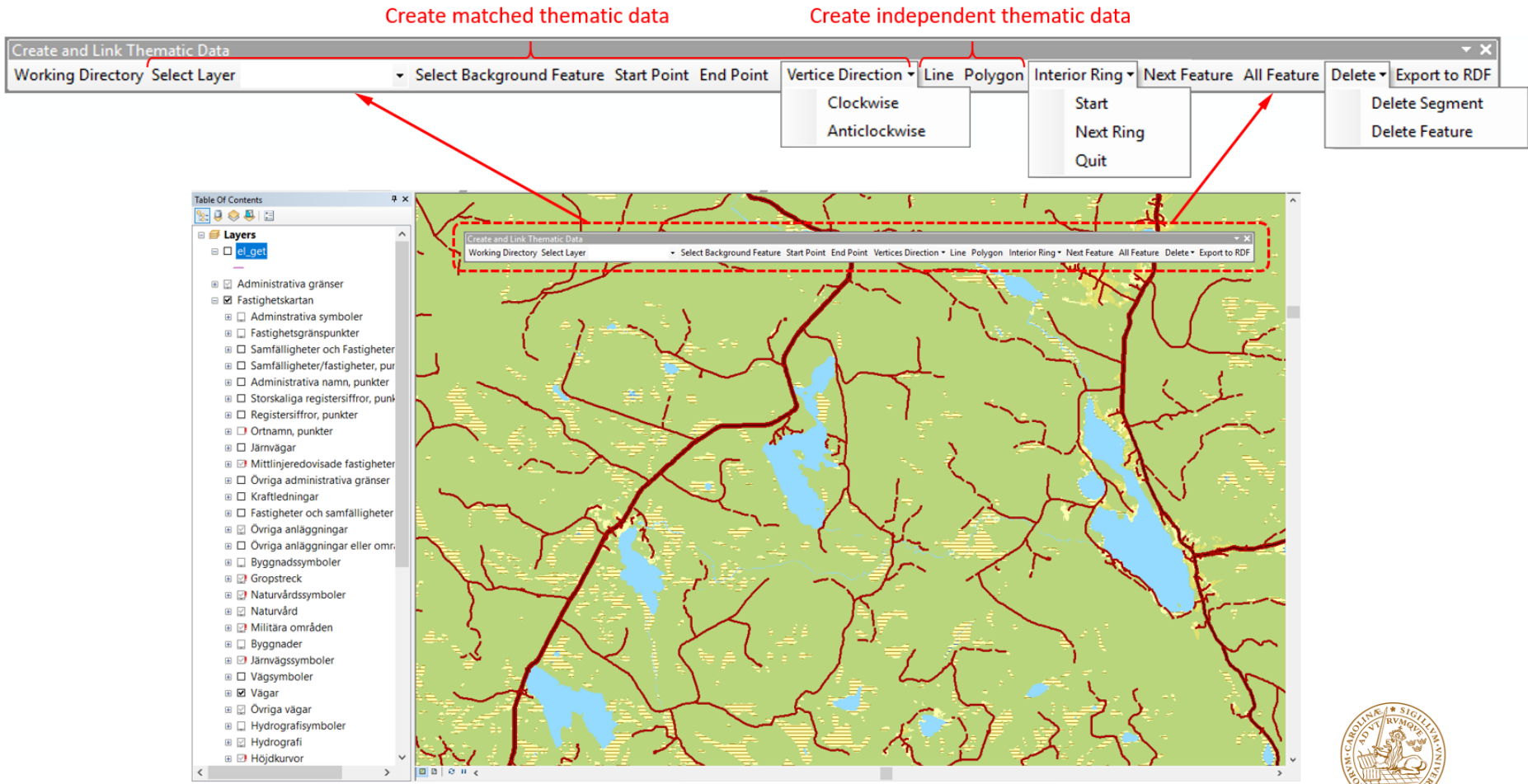
Thematic data creating tool



Haiqi Xu (2107), Master thesis, LU

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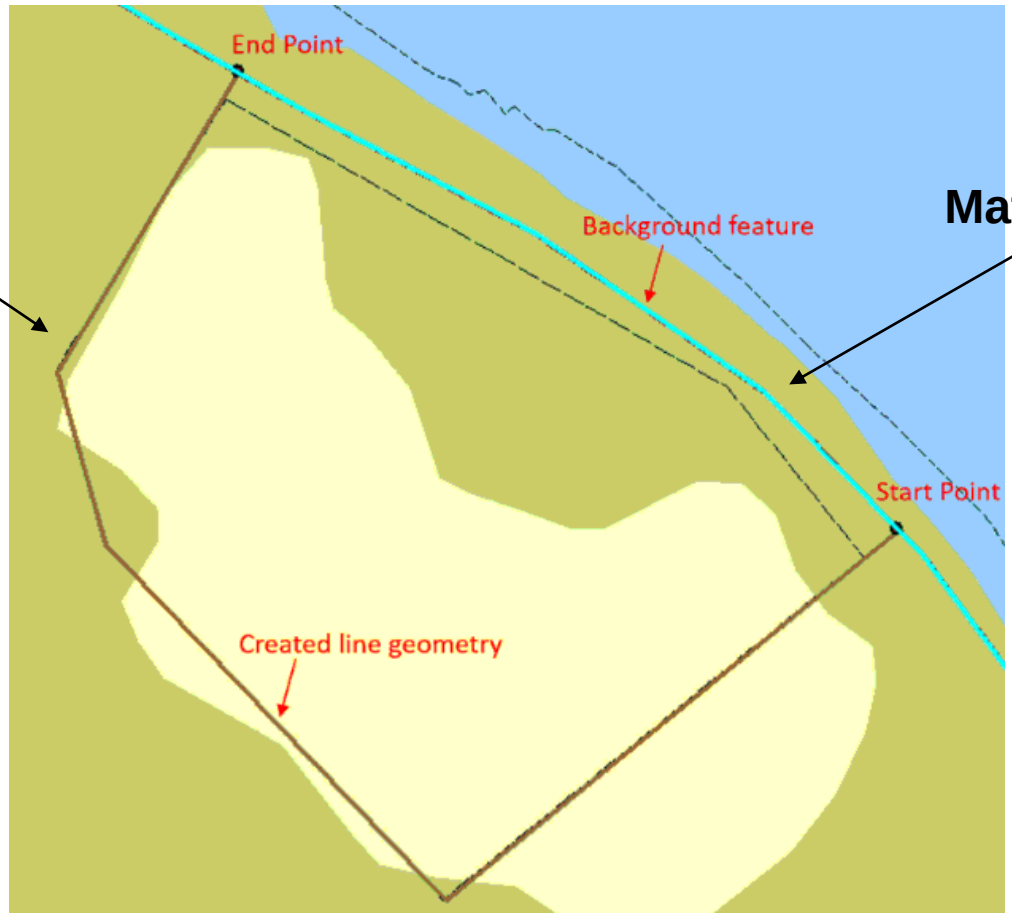
Matched and independent components



Independent component

Matched component

Haiqi Xu (2107), Master thesis, LU

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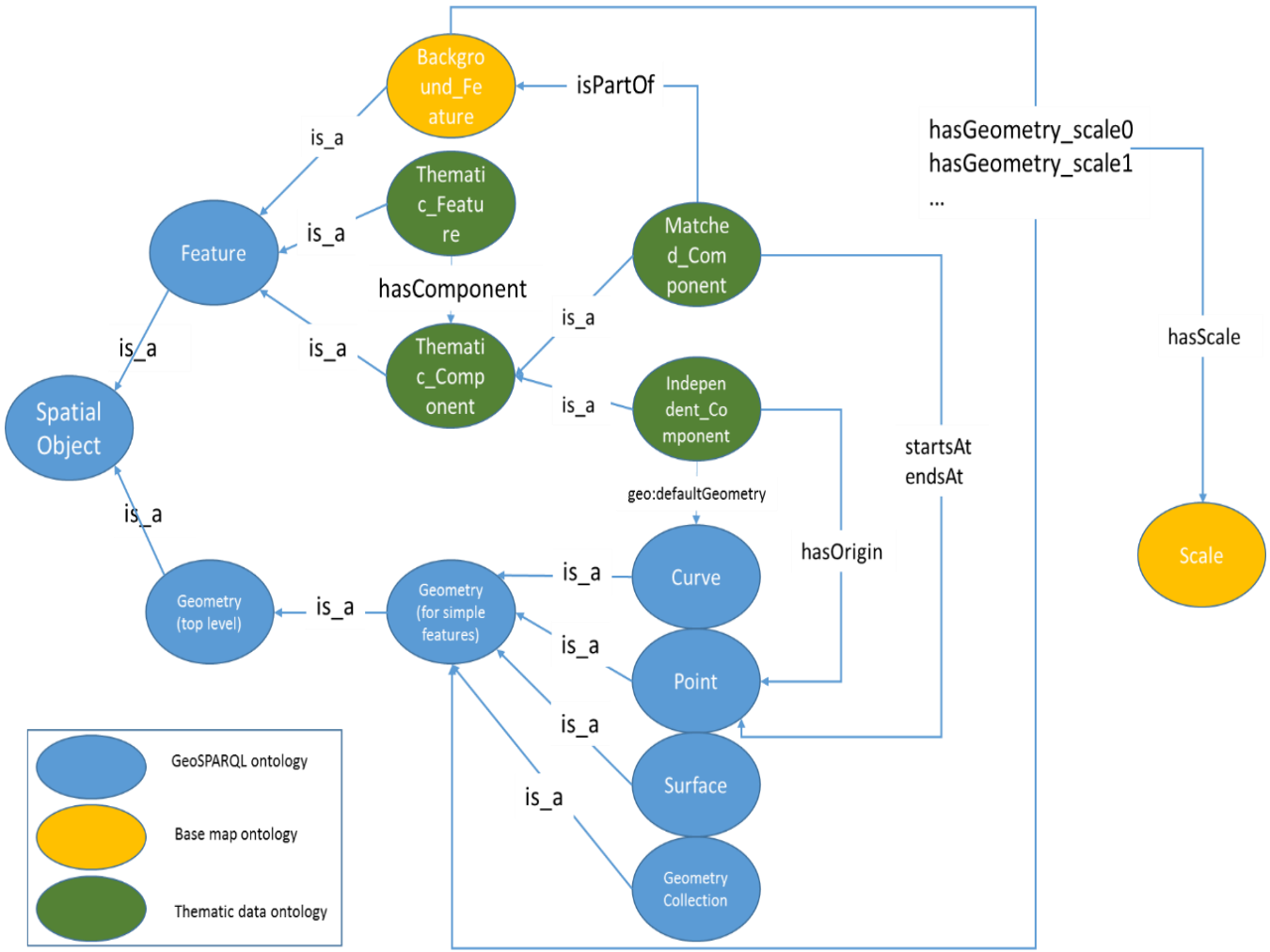
Ontology based on GeoSPARQL



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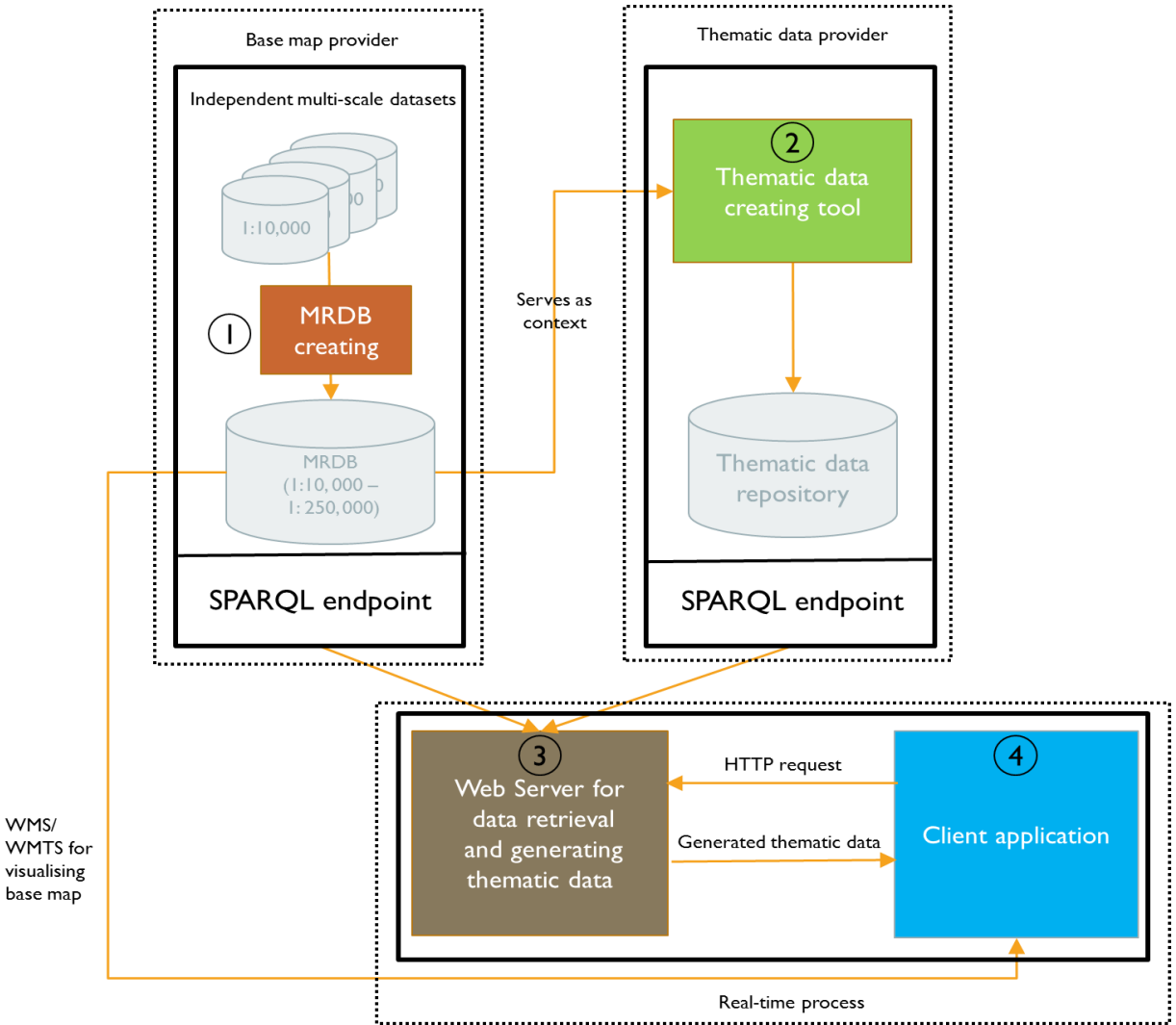
System architecture



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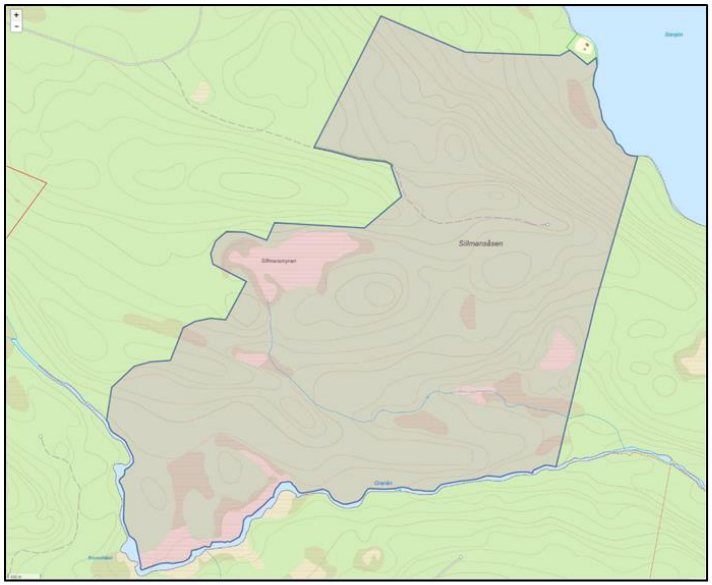
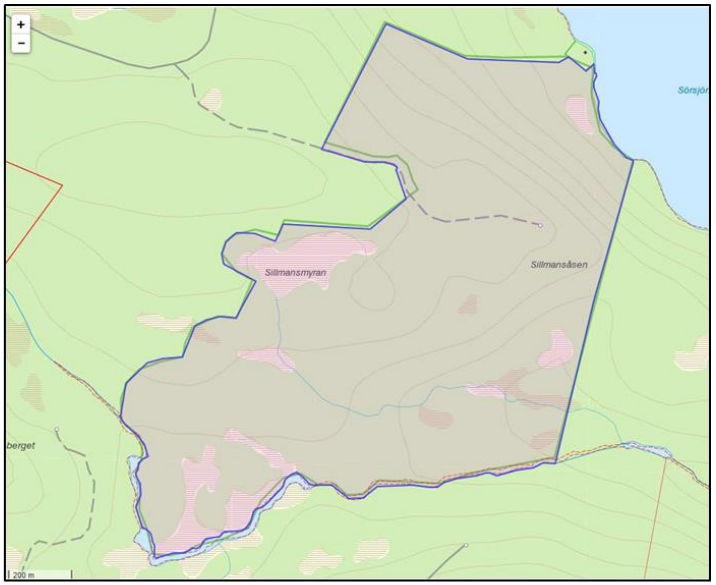
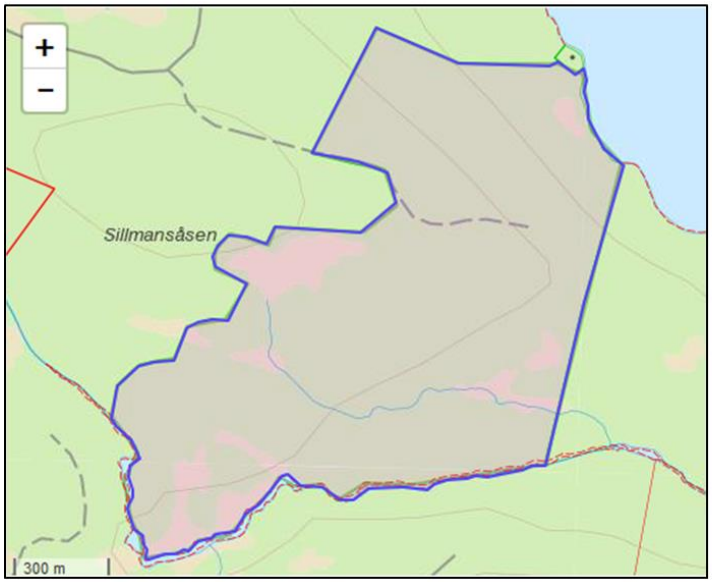
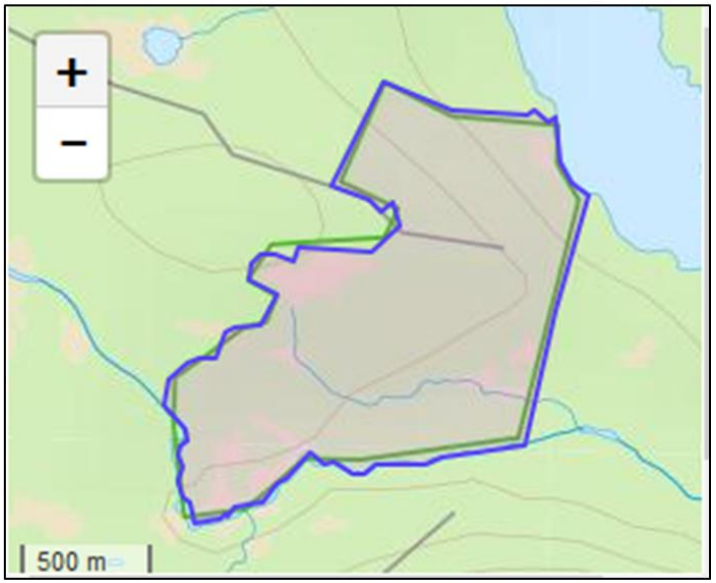






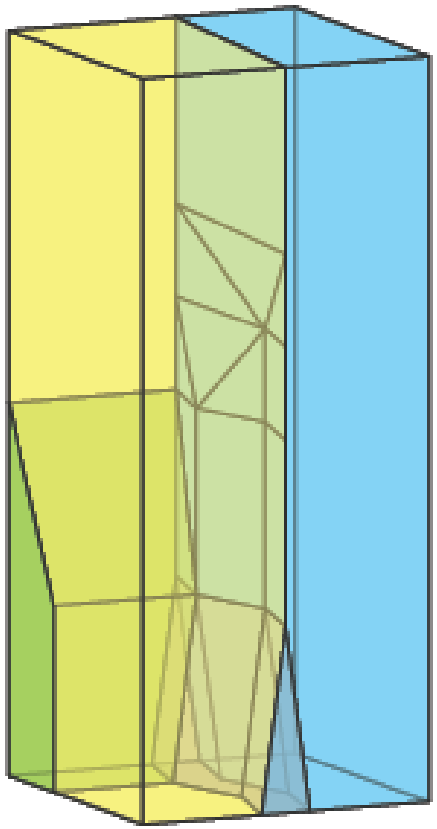


Boundary of generated natural protection areas

Boundary of reference features

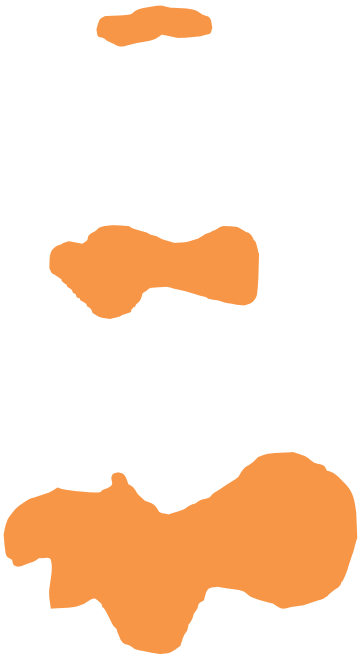
Result

3. Data integration for vario-scale representation



Reference map
Vario-scale (Delft group)

Scale



Thematic data

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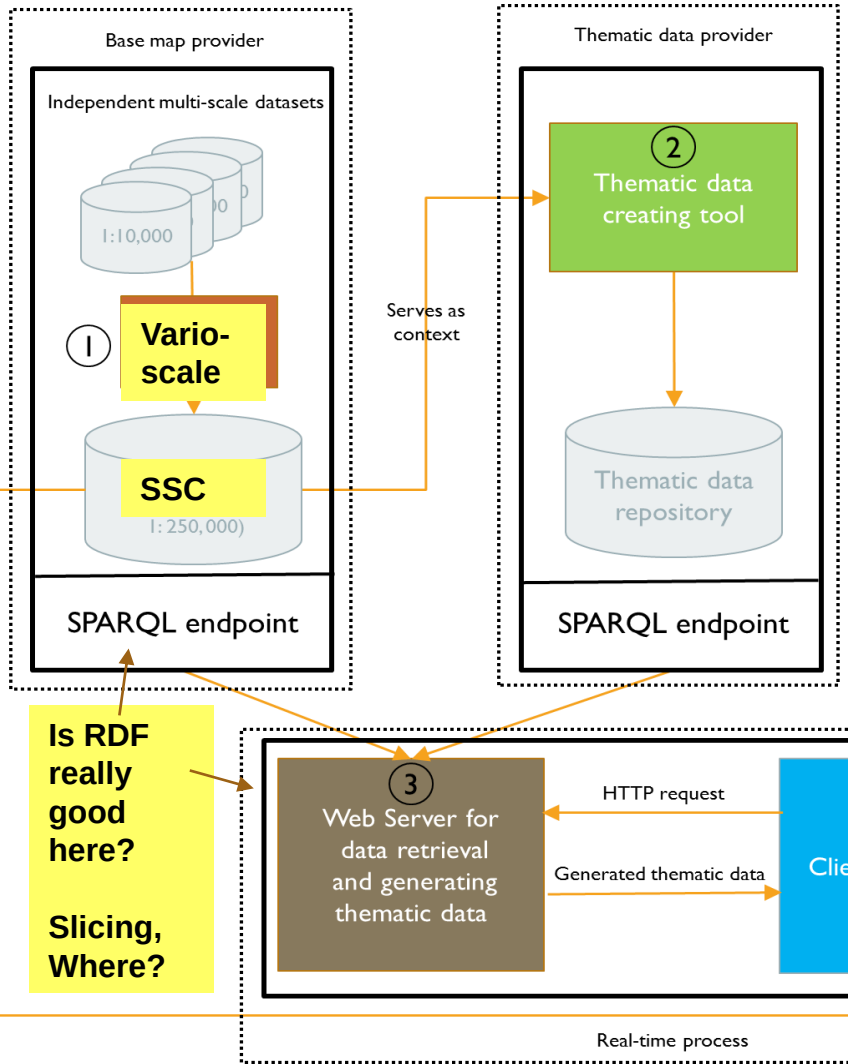
Would it be possible to use a relative positioning approach also for vario-scale base map?



The proecedure for creating thematic data would not change much

Unique identifications of objects and geometries in vario-scale representation

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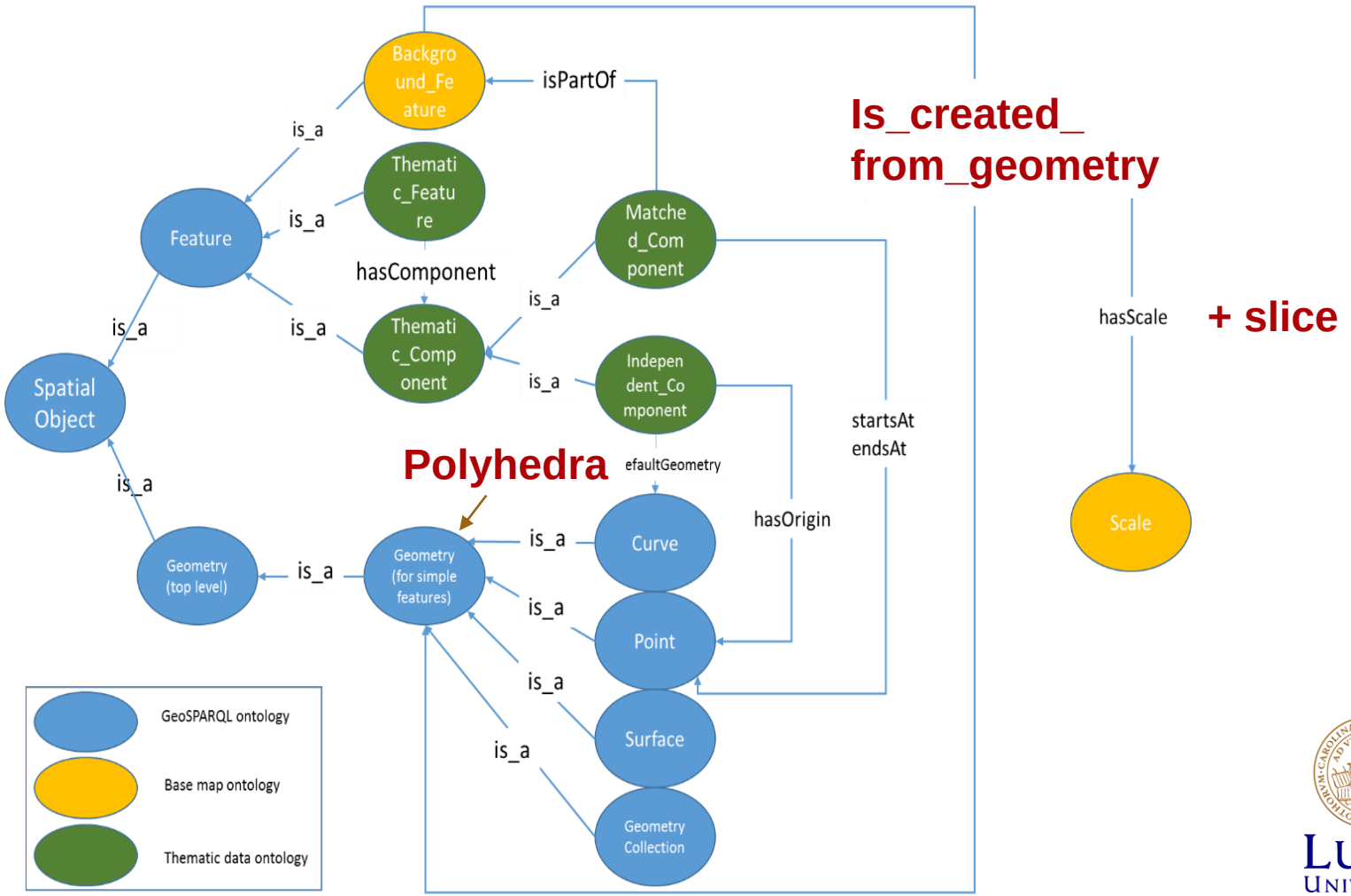
The ontology could likely be extended to include the vario-scale representation



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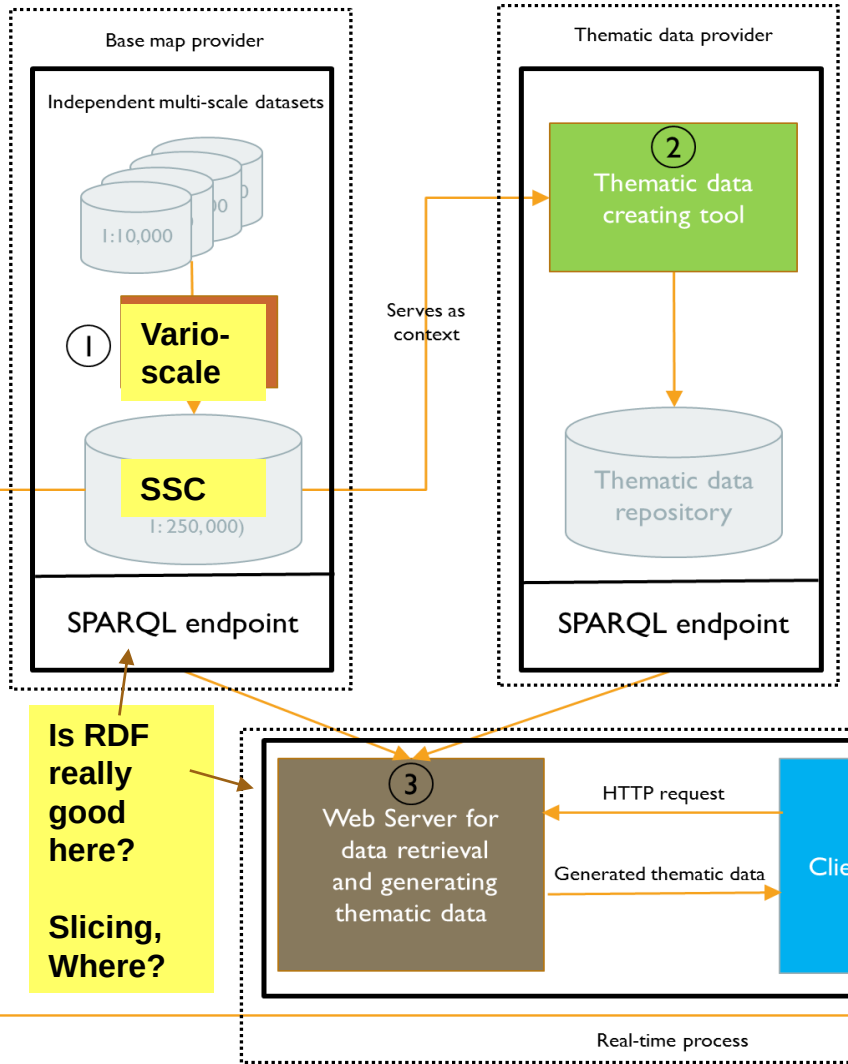
Would it be possible to use a relative positioning approach also for vario-scale base map?



The proecedure for creating thematic data would not change much

Unique identifications of objects and geometries in vario-scale representation

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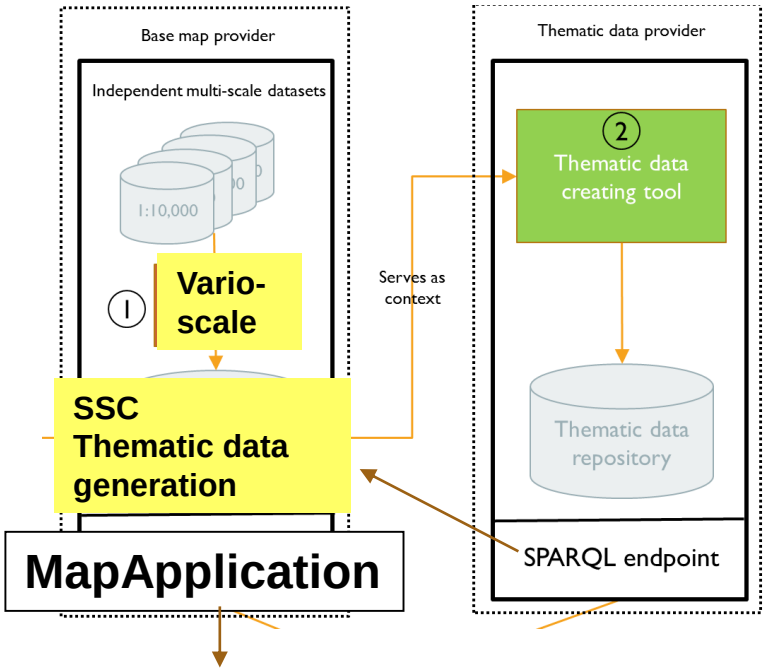
Performance issues

For performance reasons: would it be necessary to use an application server that stores the whole SSC?



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Discussion

- This work is
  - a new way of modeling spatial data on the web.
  - a way of synchronizing reference data (in multi-scale and in vario-scale) and thematic data
- Still need to think of
  - the trust issue of linked open data
  - Improving the relative positioning - using more than sharing geometric parts
  - performance issues
  - the querying potential for spatial analysis, e.g., which features share geometric parts?

Questions?

https://agile-online.org/index.php/conference/conference-2018

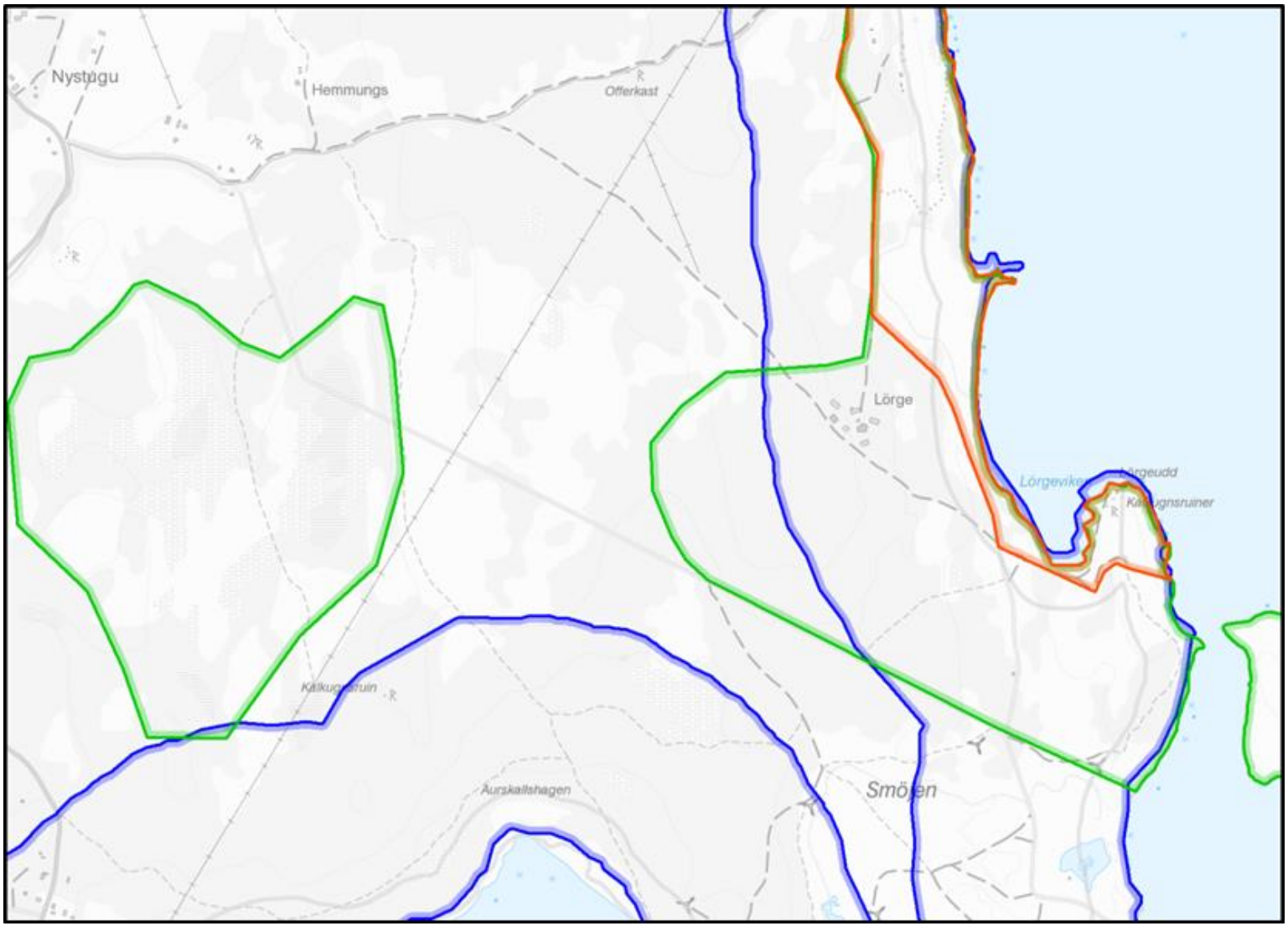
Study on design of thematic information on top of base maps

- **Should be easy to identy the extent of the thematic area/line/point**
- **The thematic information should not obscure the background map**

KIIK, A. NYSTRÖM, M., and HARRIE, L., 2017.
Cartographic Design Matters – A Usability Study of Thematic Polygon Design, ***The Cartographic Journal*****,** 54(1):24-35 **. doi: 10.1080/00087041.2016.1147191.**

Icon method based on
TOOMANIAN, A., L. HARRIE and P. OLSSON, 2012. Automatic symbolization methods for geoportals. ***The Cartographic Journal,*** **Vol. 49, No. 2, pp. 153-163.**
doi: 10.1179/1743277411Y.0000000028

Design 1: only boundaries



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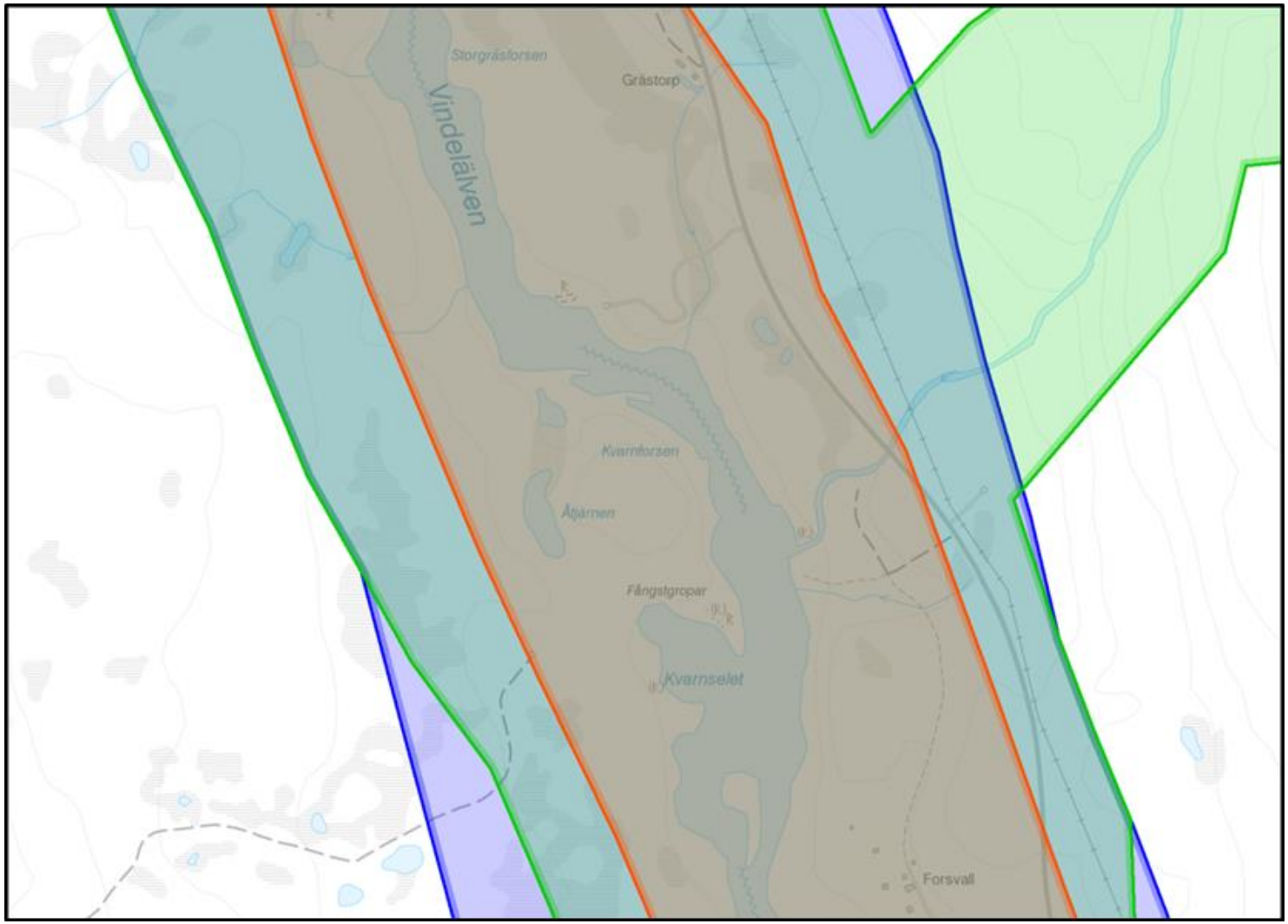
Design 2: transparency



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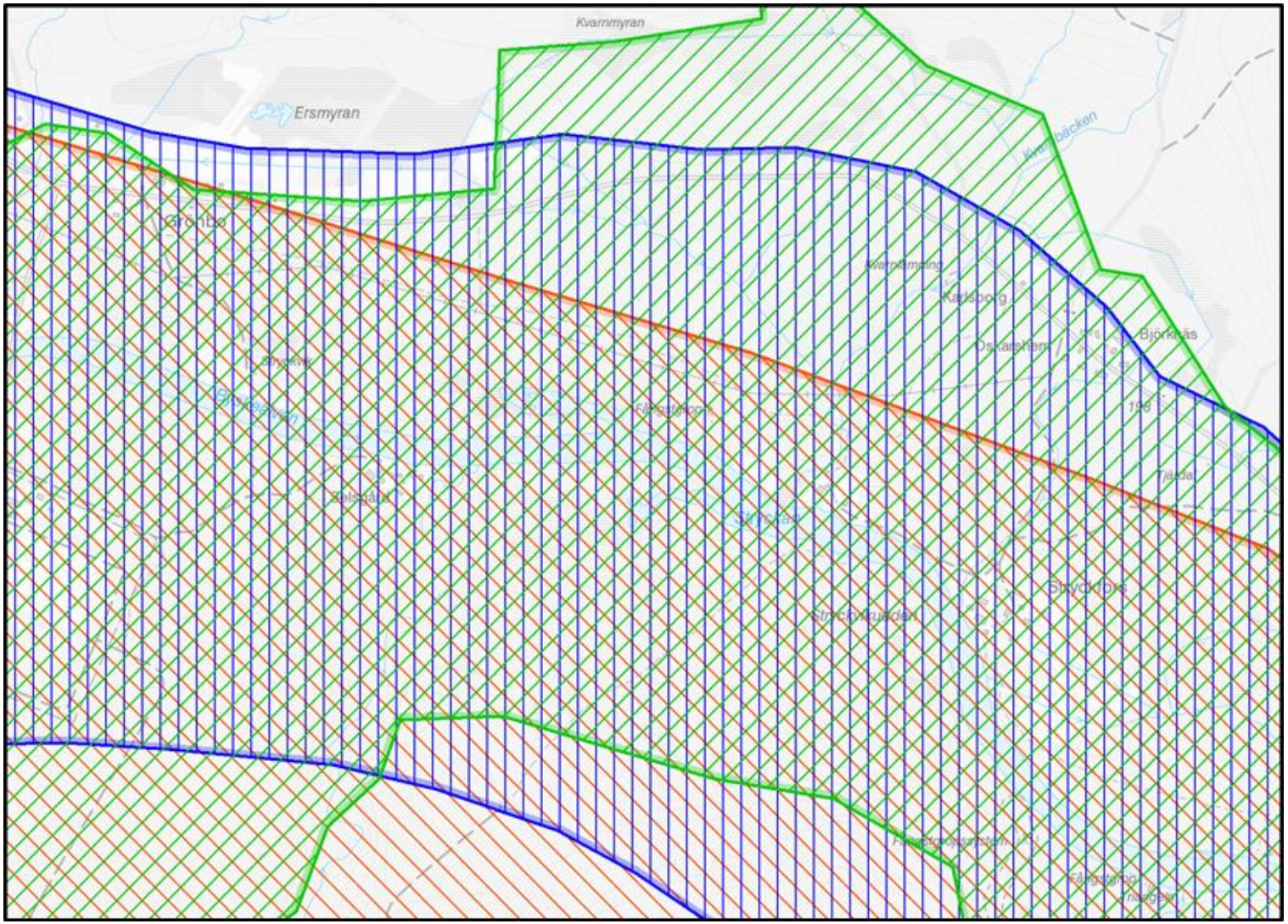
Design 3: hatches



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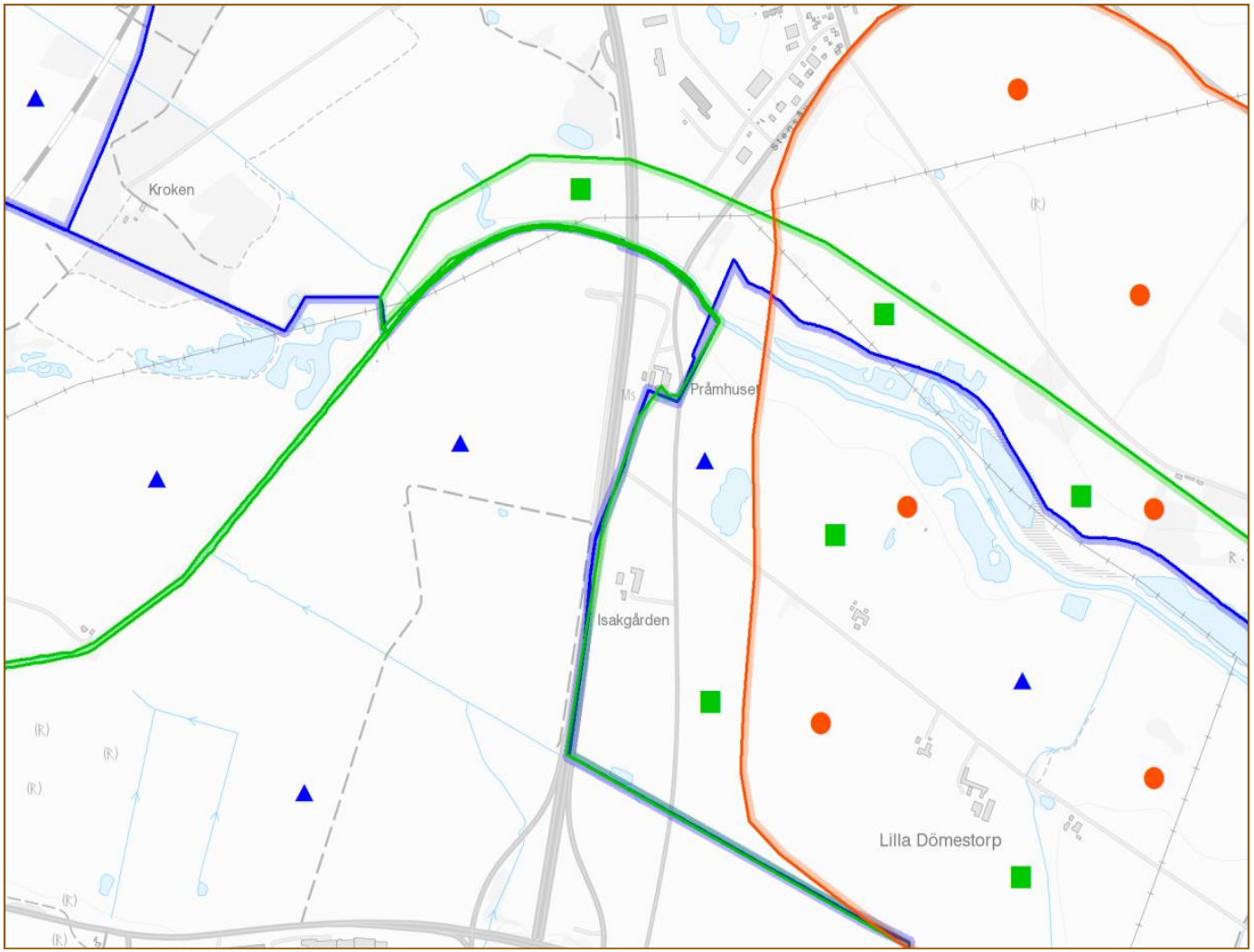
Design 4: icons



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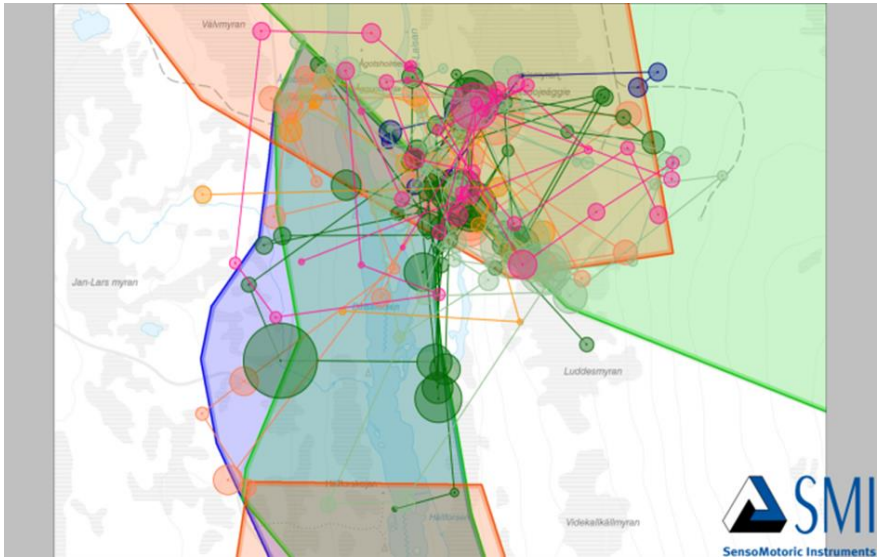
Vålvmyran
Jan-Lars myran
Lill-Lassån
Båtsaforsen
Luddesmyran
Videkallkällmyran
SMI
SensoMotoric Instruments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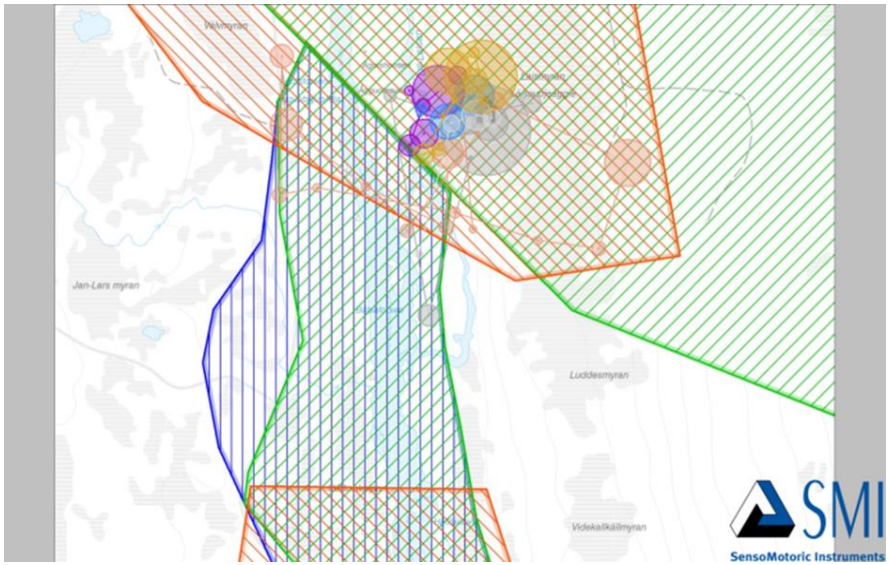
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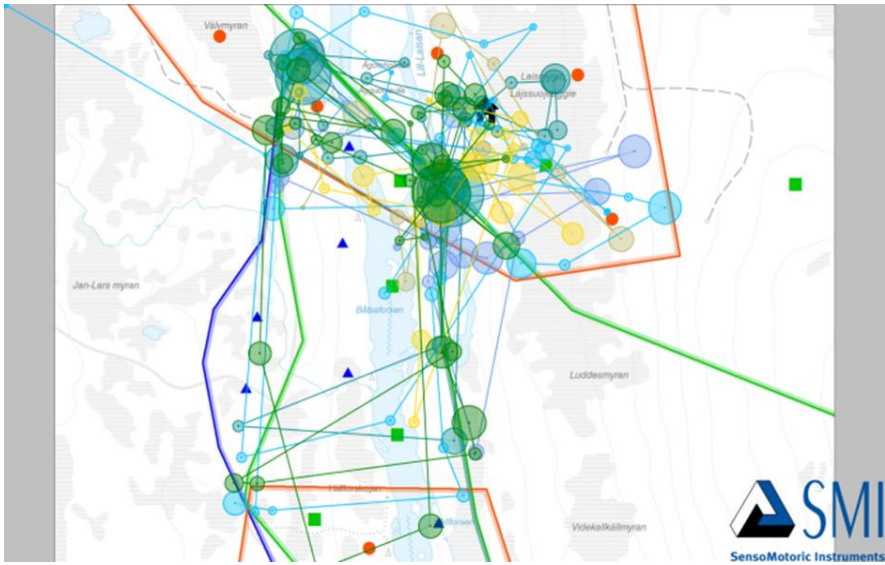
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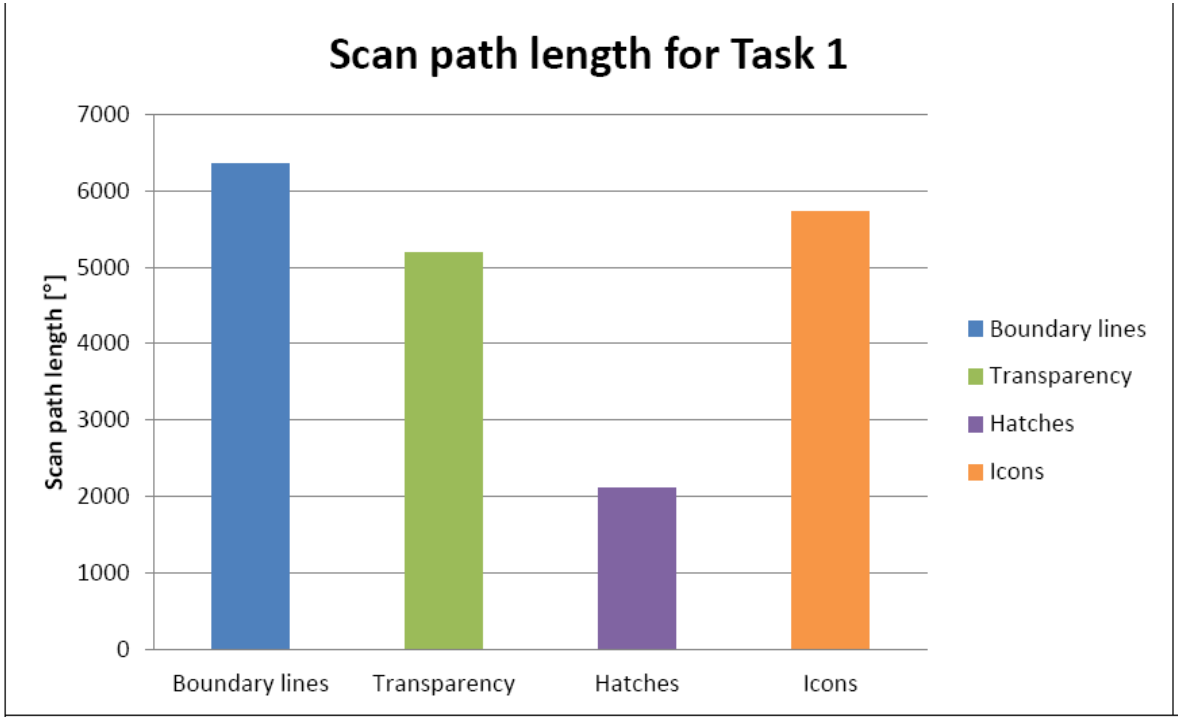
Scan path length for Task 1
Scan path length [°]
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5000
4000
3000
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1000
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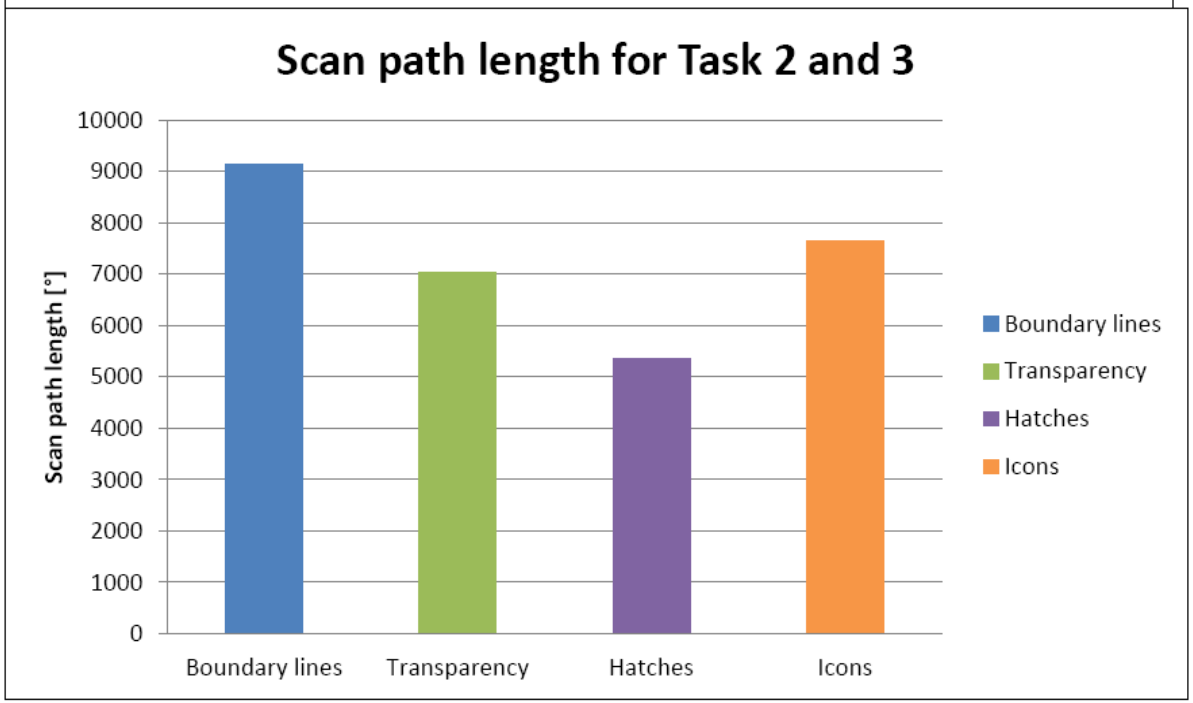
Boundary lines
Transparency
Hatches
Icons
Boundary lines
Transparency
Hatches
Icons


Scan path length for Task 2 and 3
Scan path length [°]
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4000
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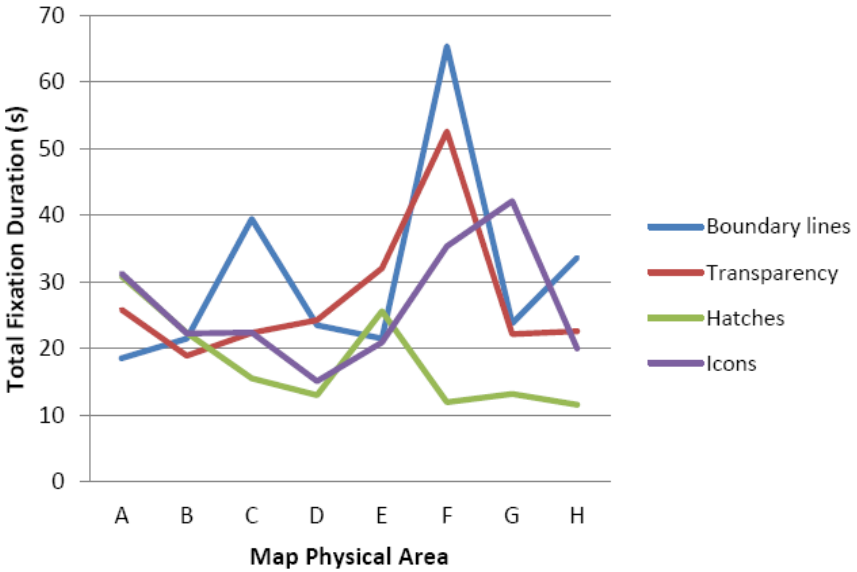
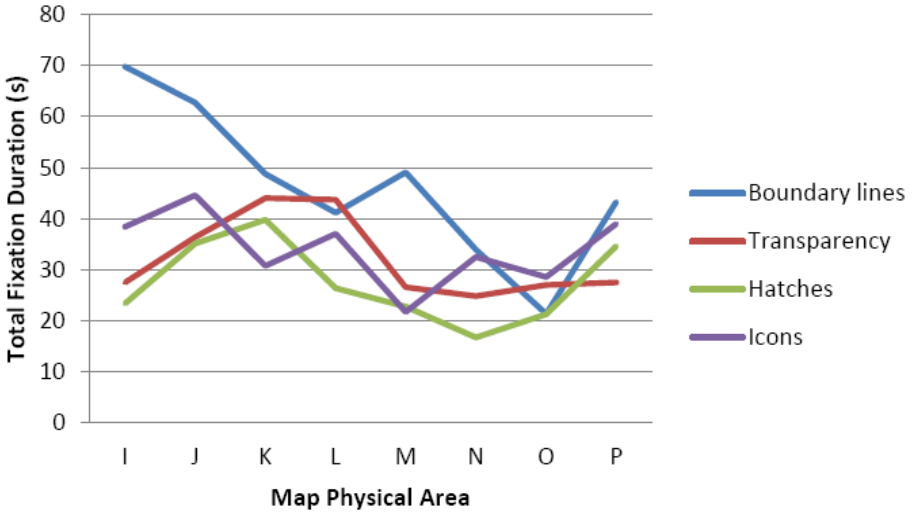
Boundary lines
Transparency
Hatches
Icons
Boundary lines
Transparency
Hatches
Icons

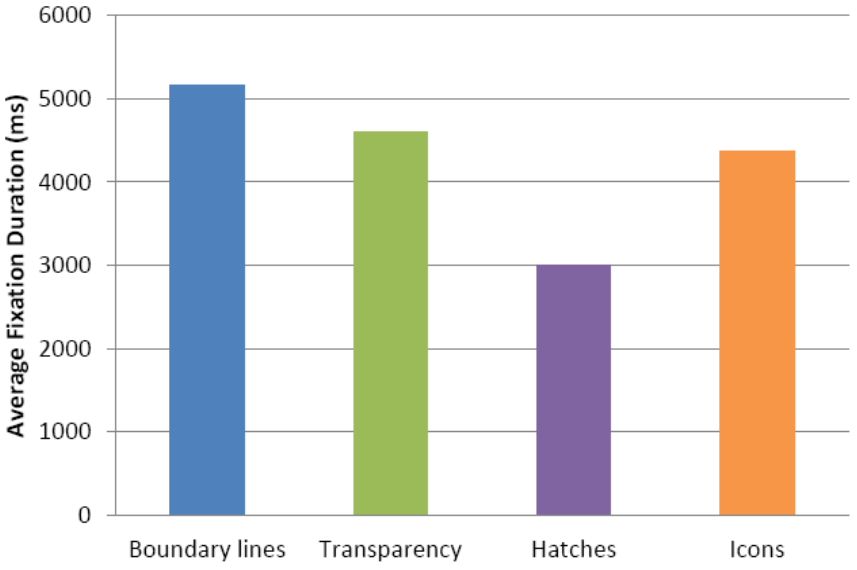
Total Fixation Duration (s) for Task 1



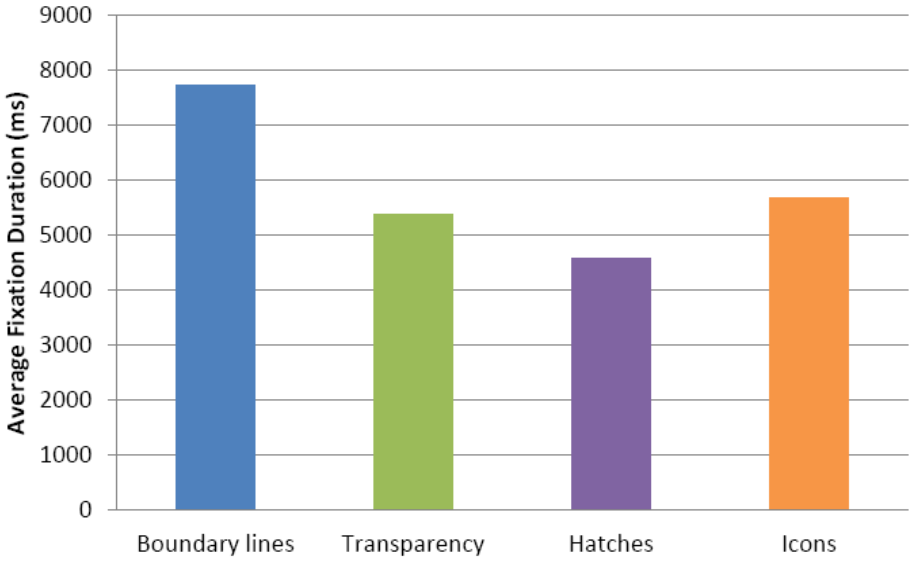
Total Fixation Duration (s) for Task 2 and 3

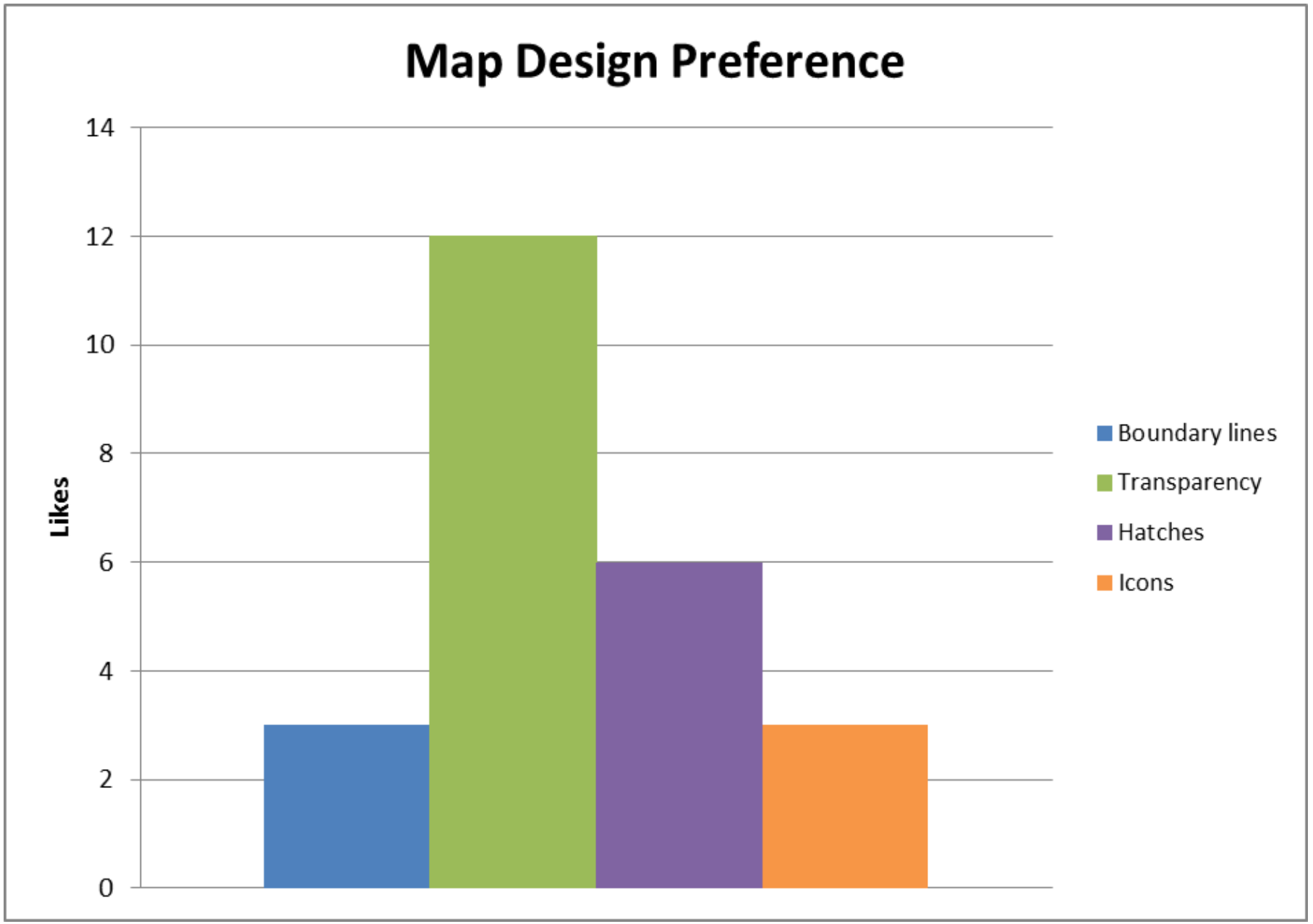


Average fixation duration (ms) for Task 1



Average fixation duration (ms) for Task 2 and 3




Map Design Preference
Likes
14
12
10
8
6
4
2
0
Boundary lines
Transparency
Hatches
Icons