D06

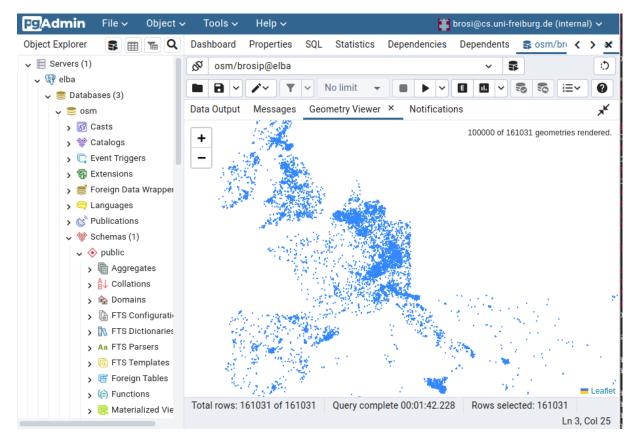
Efficient Interactive Visualization of Large Geospatial Query Results

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Exploring Geospatial Query Results

Existing Map UIs cannot handle large results

Query: All farm buildings



- Overpass turbo

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 2 way[building=farm];
 3 relation[building=farm];
 4);
 5 out geom;

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- X Sluggish, Not Complete
- X Very Sluggish, Crashes Browser
- Existing map UIs quickly become unresponsive, even for moderate result set sizes, or have a limit on the number of objects
- Results are typically sent completely (in some serialization format) to the map UI, overloading the client

Our Approach

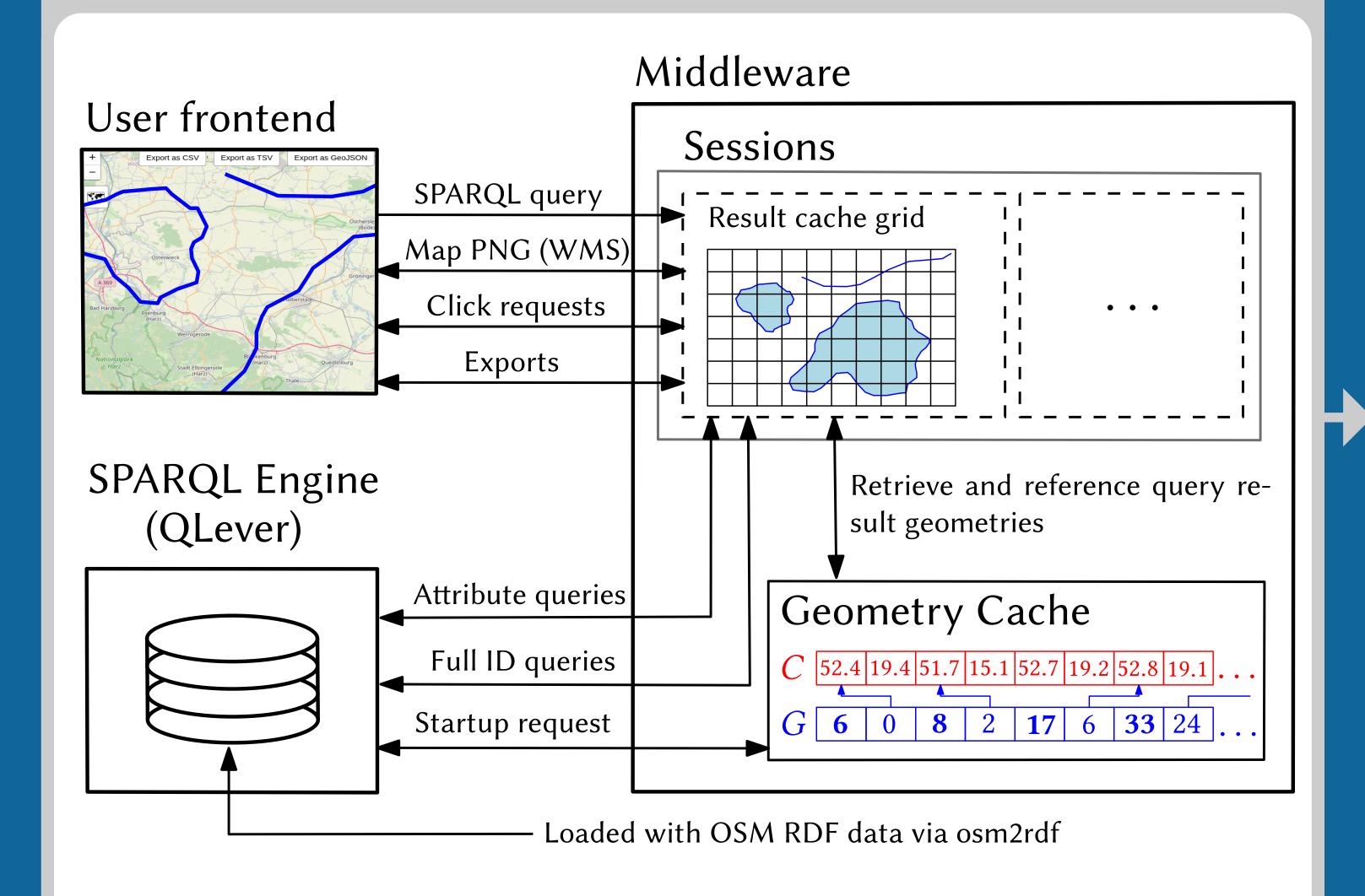
Bottleneck 1: Transferring query results from DB to map UI

Bottleneck 2: Managing many objects in the web browser

Idea

- Keep all geometries in a middleware index
- Prepare geometries for fast rendering
- During query time, only transfer raw geometry IDs from DB
- Render maps on the **server side**
- Load additional object data only on interaction (click or pan)

Architecture



SPARQL Queries

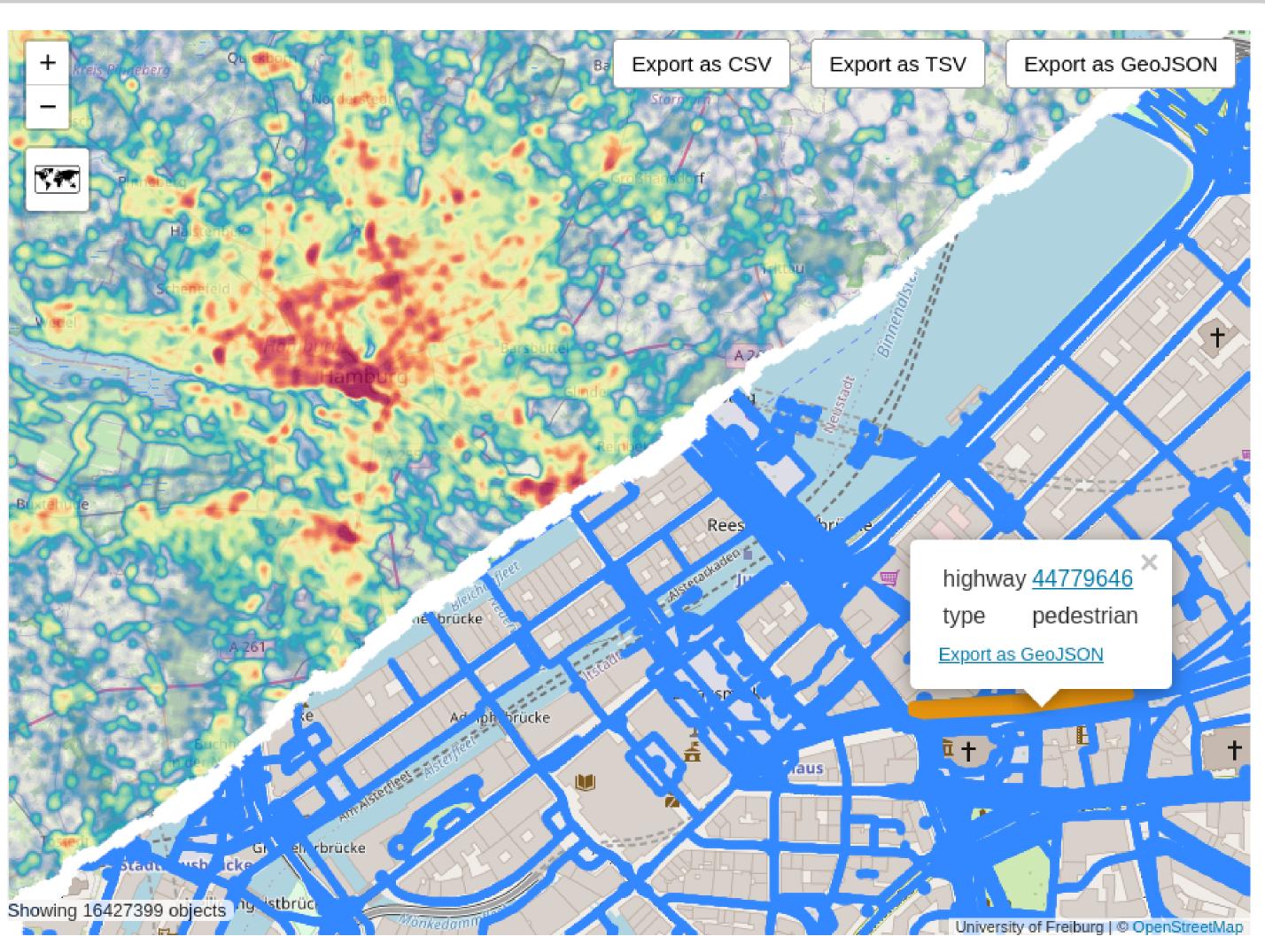
Example query: All streets in Germany

```
SELECT ?highway ?type ?geometry WHERE {
   ?highway geo:hasGeometry ?geometry .
   ?highway osmkey:highway ?type .
   osmrel:51477 ogc:sfContains ?highway .
}
```

Evaluated queries:

- (Q1) The building with OSM way id 98284318
- (Q2) All castle buildings (building=castle)
- (Q3) All train station buildings (building=train_station)
- (Q4) All farm buildings (building=farm)
- (Q5) All residential buildings (building=residential)
- (Q6) All streets (highway=*)

Map UI: Heatmap and Object Map



https://qlever.cs.uni-freiburg.de/osm-planet

Results

Time to interactive UI (including query time):

			•		
	#objects Overpass		pgAdmin	OSCAR	ours
Q1	1	120 ms	0.1 s	0.1 s	0.2 s
Q2	2.5 k	8.8 s	1.6 s	0.3 s	0.4 s
Q3	48 k	2 m	6.1 s	1.2 s	0.5 s
Q4	358 k			3.9 s	0.7 s
Q5	15 M				7.3 s
Q6	218 M				1.5 m

Time to interactive UI after zoom (t_Z) and map pan (t_P) :

	Overpass		pgAdmin		OSCAR		ours	
	t_Z	t_P	t_Z	t_P	t_Z	t_P	t_Z	t_P
Q1	0 ms	0 ms	0 m	s 0 ms	0.1 s	10 ms	53 m	s 66 ms
Q2	0.2 s	30 ms	0.1 s	20 ms	0.1 s	70 ms	0.3 s	0.1 s
Q3	2.9 s	2.3 s	1.2 s	0.3 s	0.3 s	80 ms	0.4 s	0.1 s
Q4					0.7 s	1.2 s	0.3 s	0.1 s
Q5							0.3 s	0.1 s
Q6							0.4 s	0.1 s