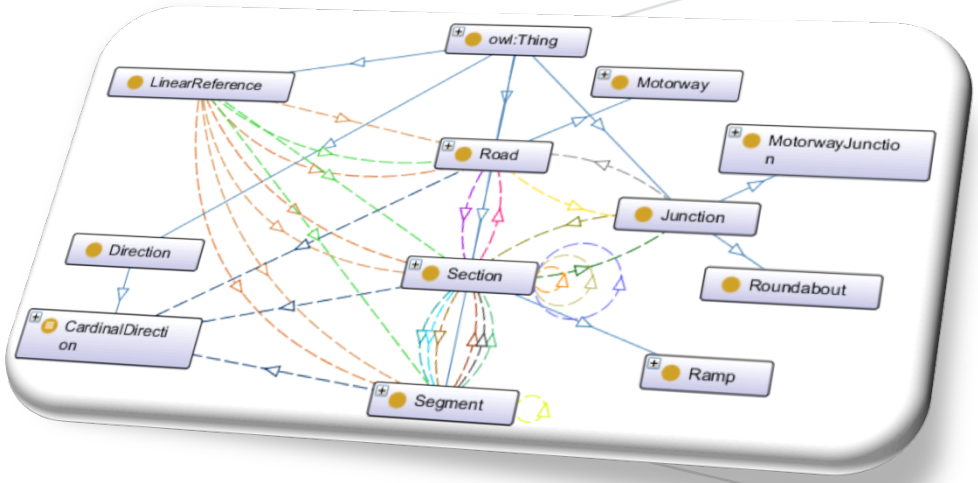

salzburgresearch

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Generation of Meaningful Location References

LBS Symposium 2016, November, 14-16th, Vienna

Overview

- Motivation
- Location Referencing Systems (LRS)
- Problem Definition and Related Work
- Approach: Qualitative Location Referencing (QLR)
- Methodology – 3-Steps-Approach
- Generation Process for Location References
- Plausibility Check
- Conclusion and Future Work

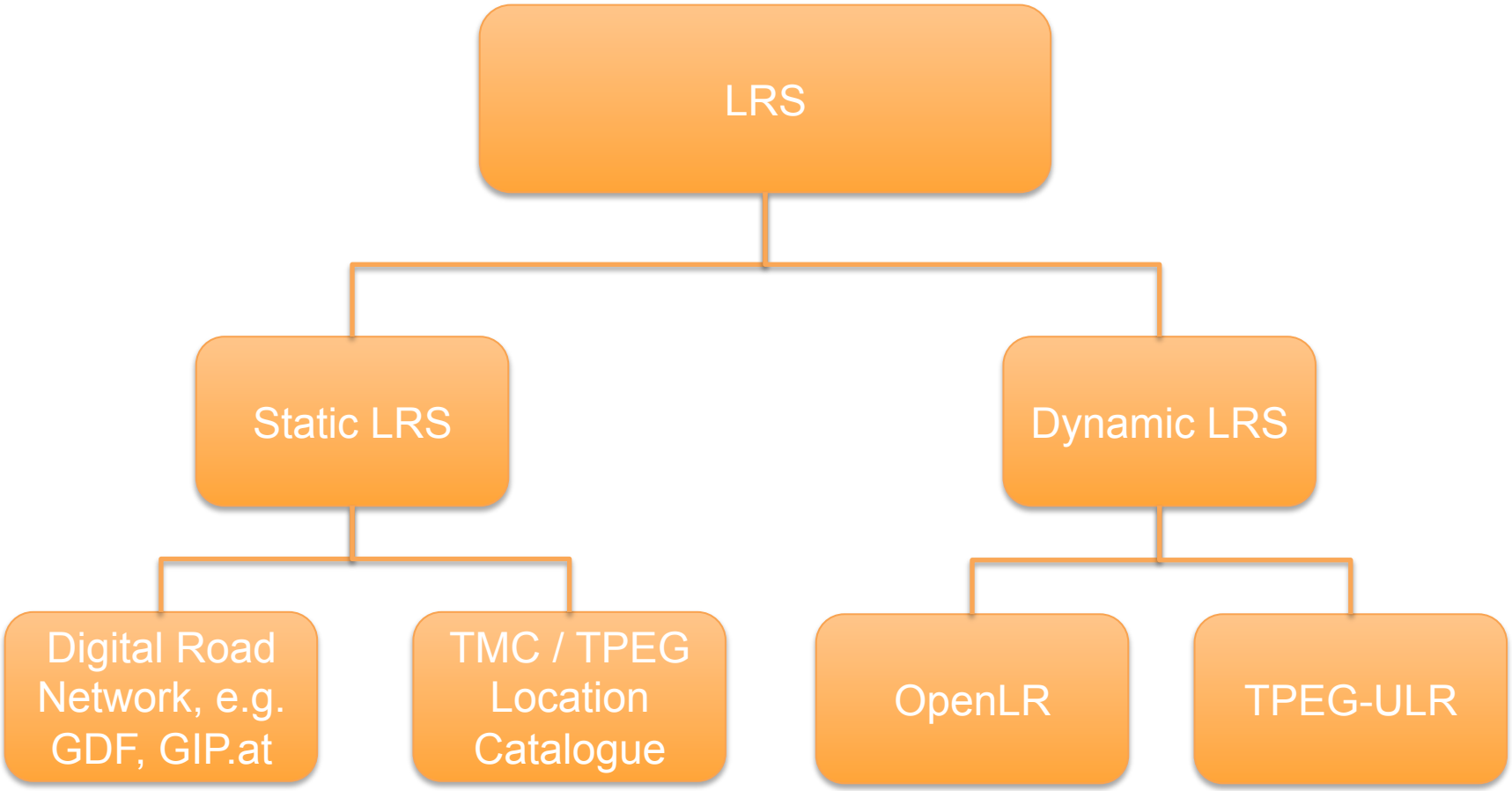
Motivation

„On motorway A1 Westautobahn in travel direction Salzburg between exit Wallersee and Salzburg Nord at kilometer 286 be aware of a broken vehicle.“

Message parts		**Concepts**
▪ On motorway A1 Westautobahn	←	**Road**: Category, road code and name
▪ in travel direction Salzburg	←	**Direction**: Qualitative direction concept
▪ between exit Wallersee and Salzburg Nord	←	**Junction**: Name **Section**: between two junctions
▪ at kilometer 286	←	**Linear Reference**: Location
▪ be aware of a broken vehicle	←	**Traffic Event**: broken vehicle

Location Referencing: How to digitally model location references

Location Referencing Systems (LRS)



Problem Definition and Related Work

LRS	Reference to road network	Machine Readability	Human Readability	Dynamic referencing	Automated Process	Data Exchange
Road network graph	Yes	Yes	No	Partly	Partly	No
Location Catalogue, e.g. TMC / TPEG-LOC	No	Yes	Partly	No	No	Partly
TPEG-ULR	No	Yes	No	Yes	Yes	Yes
OpenLR	No	Yes	No	Yes	Yes	Yes

Location Referencing

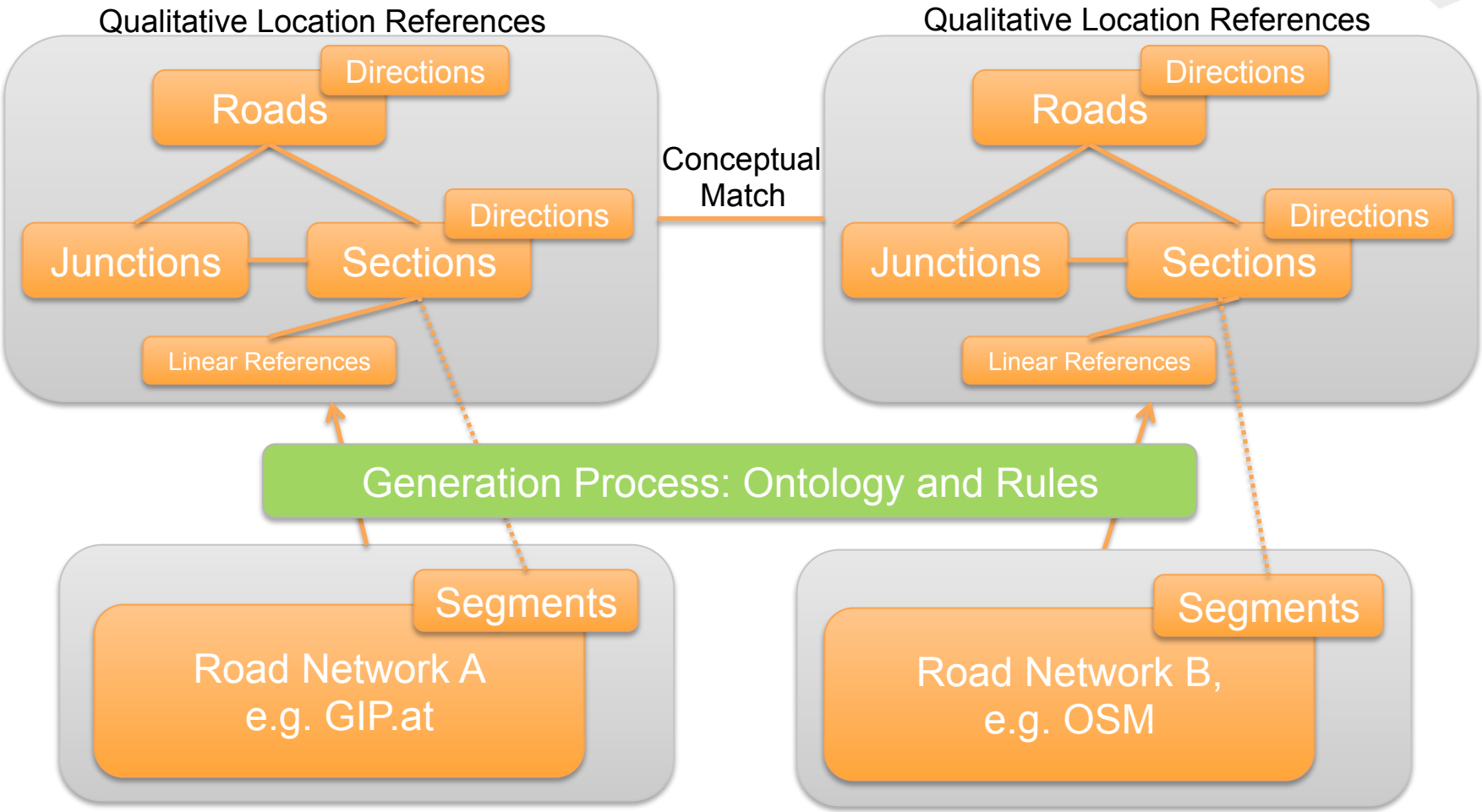
- Nyerges (1990): location referencing strategies for highways
- Vonderohe et al. (1997): generic data model for location referencing
- Scarponcini (2002): generalized model for linear referencing
- Curtin et al. (2007): process for linear referencing

Research Gap

Conceptual modelling approaches

- Timpf et al. (1992): conceptual model for highway navigation
- Car and Frank (1994): hierarchical algorithm for path search
- Timpf (2002): ontology of wayfinding from a traveller‘s perspective
- Wang and Meng (2009): hierarchical ontology for modelling road networks on multiple scales

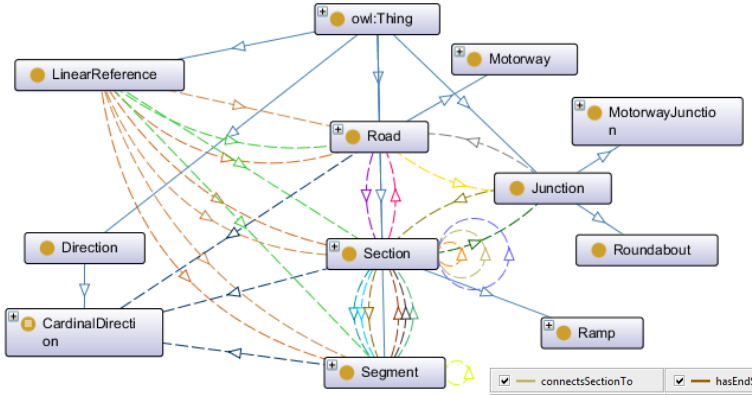
Our Approach: Qualitative Location Referencing (QLR)



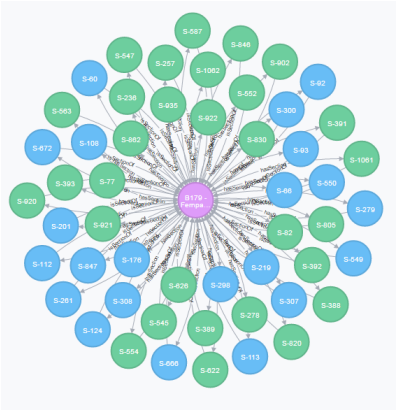
Overall Methodology – 3-Steps-Approach

1 Road Network Graph

2 Ontology and Rules

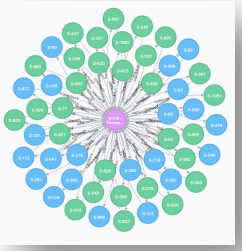


3 Generation of Location References



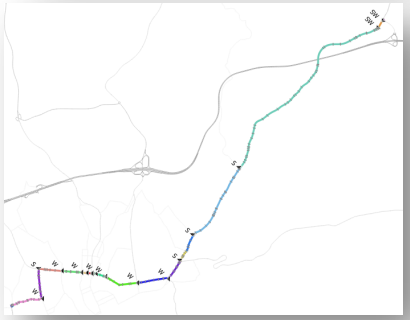
Generation Process for Location References

1. Import road network graph (e.g. as graph model in Neo4J database) and ontology (e.g. as OWL – Web Ontology Language)



2. Generate individuals and relationships for Roads and Sections (using road codes/names and topological information)

3. Generate individuals and relationships for Junctions (including on/off ramps)



4. Determine Directions of Roads and Sections (e.g. Cardinal Directions)

→ Individuals and relationships may be stored as OWL in the database or exported

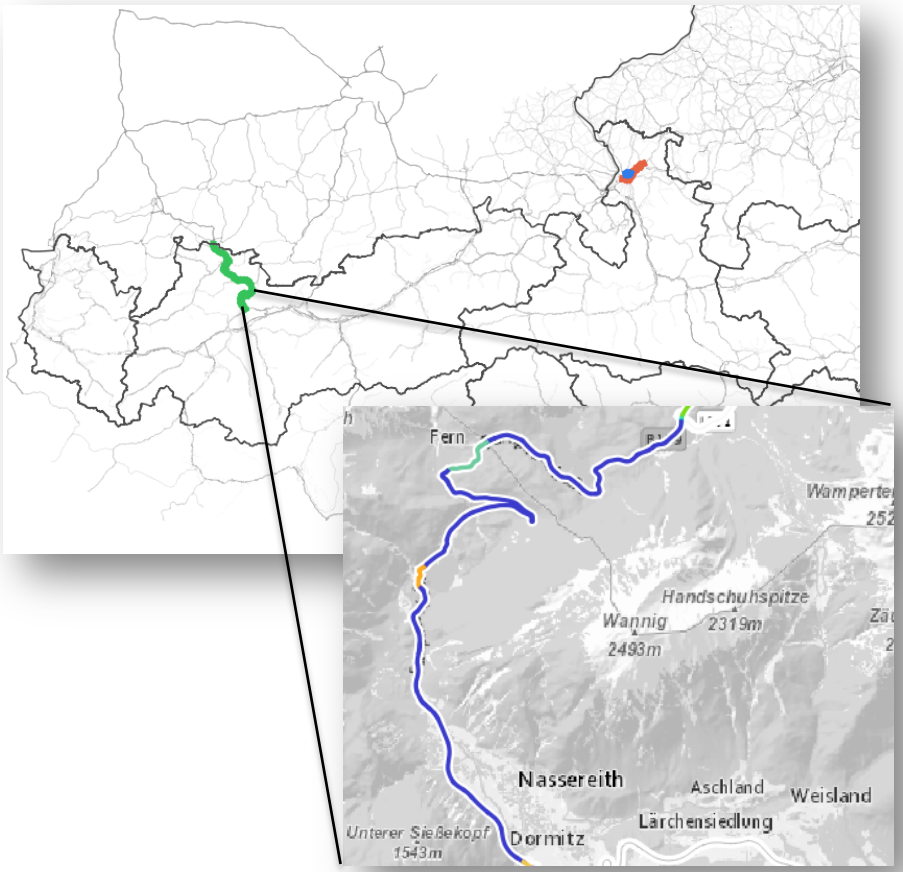
Plausibility Check

- Q1: Are roads and sections adequately represented on different levels of abstraction?
- Q2: How well does the modelling of junctions work?
- Q3: How can we use junctions as selector for between-sections?
- Q4: Does the qualitative direction concept proof useful?

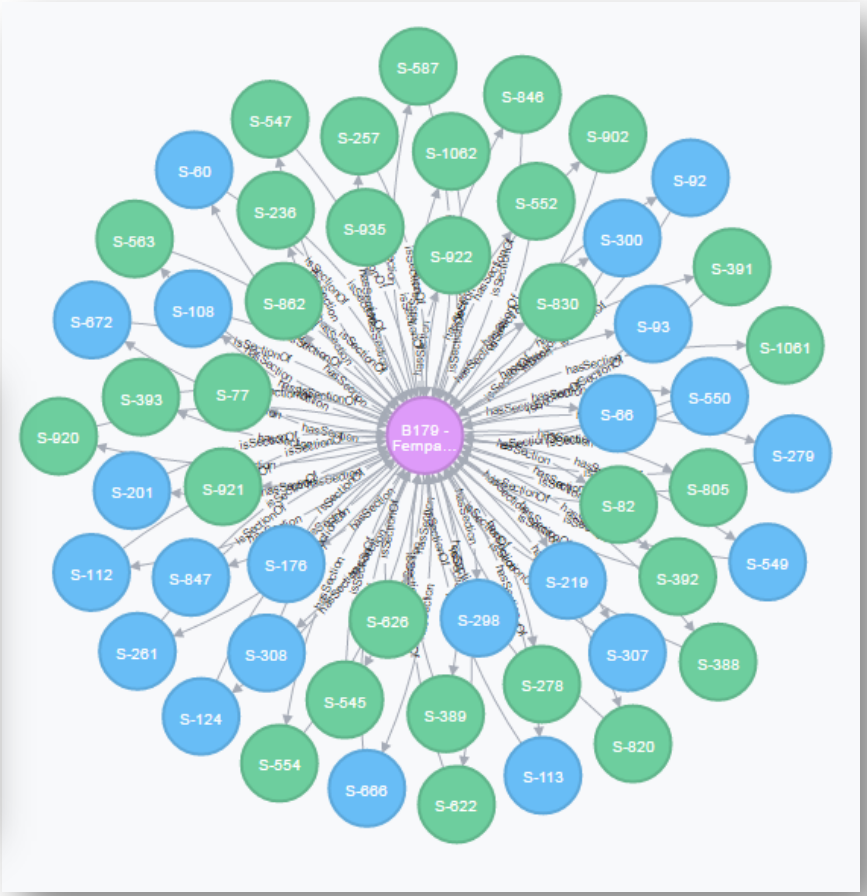
- Test dataset
  - Austria's National Transport Graph (GIP.at) -> available as OGD
  - Import of the topologically connected road network from the provided CSV file
  - Filter on functional road classes (FRC) 0-4 resulted in 223.328 road segments
  - Execution of the proposed generation process

- Results
  - 25.072 roads and 66.987 road sections

Q1: Modelling of Roads and Road Sections



Sections and Local Roads (Sections)
B179 Fernpassstraße in Tyrol



Individuals of all sections belonging to the B179 Fernpassstraße in Tyrol

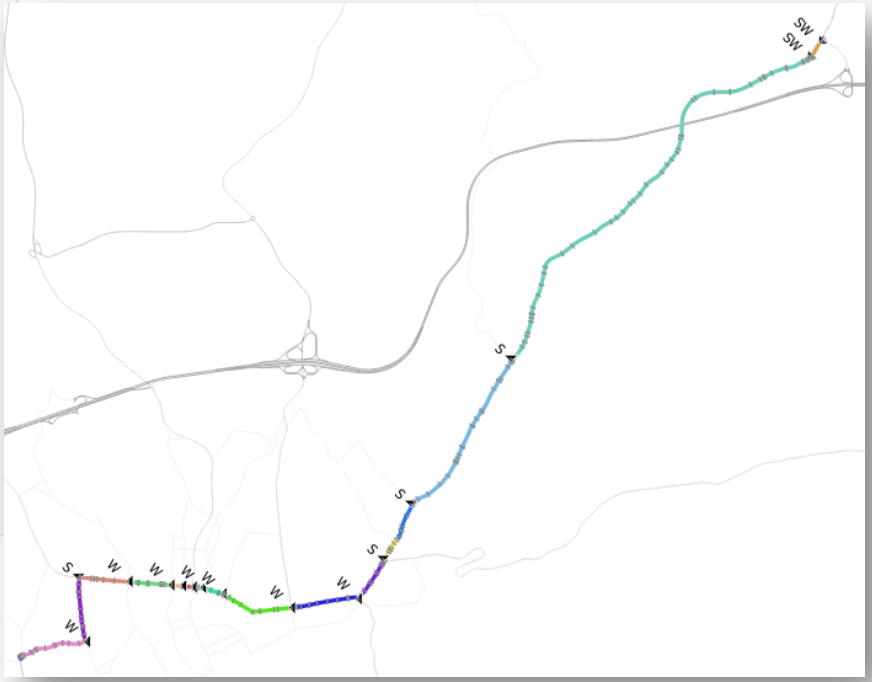
Q2: Modelling of Complex Junctions

Modelling of a complex motorway junction with several slip roads as sections
Example: Junction A1 Westautobahn with B158/B150 at Salzburg North

Q3 and Q4: Section Queries and Qualitative Directions

Qualitative Spatial Query to retrieve all sections sections of “B1 – Wiener Straße” (federal highway) between roundabout “Kreisel Eugendorf A1” and roundabout “B1 - KV Hans Schmid Platz”.

```
MATCH (j:Roundabout {name: 'Kreisel
Eugendorf A1'})-
    [:hasJunctionSection]->(n:Section)
WITH  startSec LIMIT 1
MATCH (j:Roundabout {name: 'B1 - KV Hans
Schmid Platz'})-
    [:hasJunctionSection]->(n:Section)
WITH  endSec LIMIT 1
MATCH (r:Road {roadName: 'B1 – Wiener
Straße'})-[:hasSection]->(sec)
WITH  sec
MATCH p=shortestPath((startSec)-
[:connectsSectionTo*0..9999]->( endSec))
WHERE p IN sec
WITH  p
MATCH (p)- [:hasDirection]->
    (d:CardinalDirection)
RETURN p, d
```



Conclusions and Outlook

- Conclusions
  - Approach for qualitative location referencing on multiple levels of abstraction
  - Provides human-readable, meaningful location references
  - Closes the gap between static and dynamic location referencing
  - Plausibility check with a nation-wide network graph has been accomplished
  - The quality of the generated location references depends on the quality of the network graph

- Future Work
  - Evaluation with different network graphs (e.g. GIP.at, OpenStreetMap,…)
  - Optimized recognition of complex junctions
  - More sophisticated qualitative direction concepts
  - Empirical evaluation

Thanks for your attention!

Any questions?

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