Combining indoor and outdoor navigation: the current approach of route planners

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Motivation

- Variety of outdoor navigation systems
- Efforts for indoor navigation
  - technological issues
  - indoor (3D) models
- Focus on pedestrian navigation
  - specific requirements: context, environment, mode of locomotion, scale level
  - seamless movement between indoor and outdoor space

➡ Need to extend outdoor navigation systems to the indoor world!

Research goal and assumptions

Goal:

state of the art in integration of indoor infrastructures for navigation → based on what route planners do
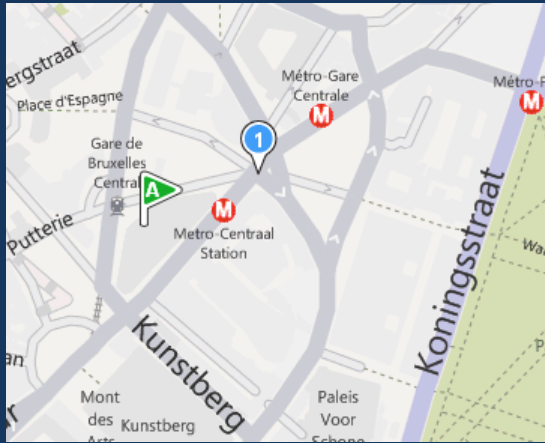
Resources and assumptions:

- 'common' outdoor route planners
- indoor infrastructures
- pedestrian navigation

➡ Route planner integration with 2 focuses:
- How do they handle indoor data?
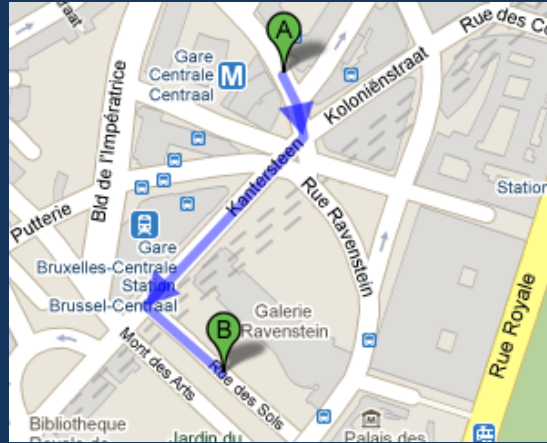- How are indoor addresses linked to spatial data?

1. Use of indoor data

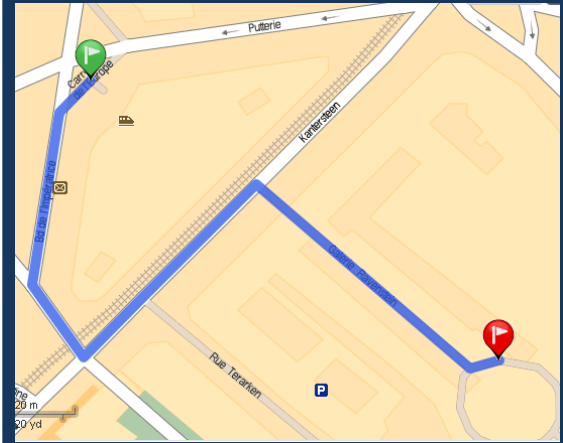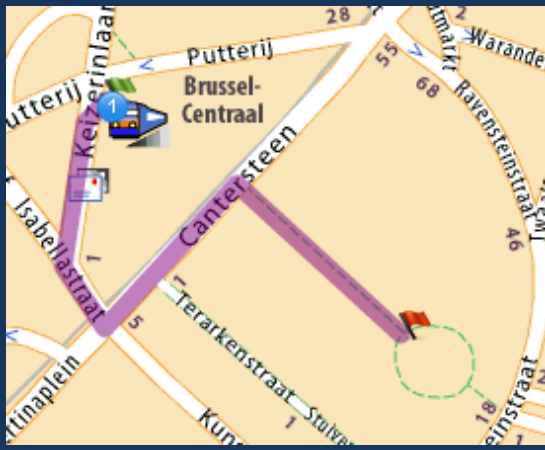## Indoor infrastructure part of the shortest path

Bing

Google Maps

Mappy

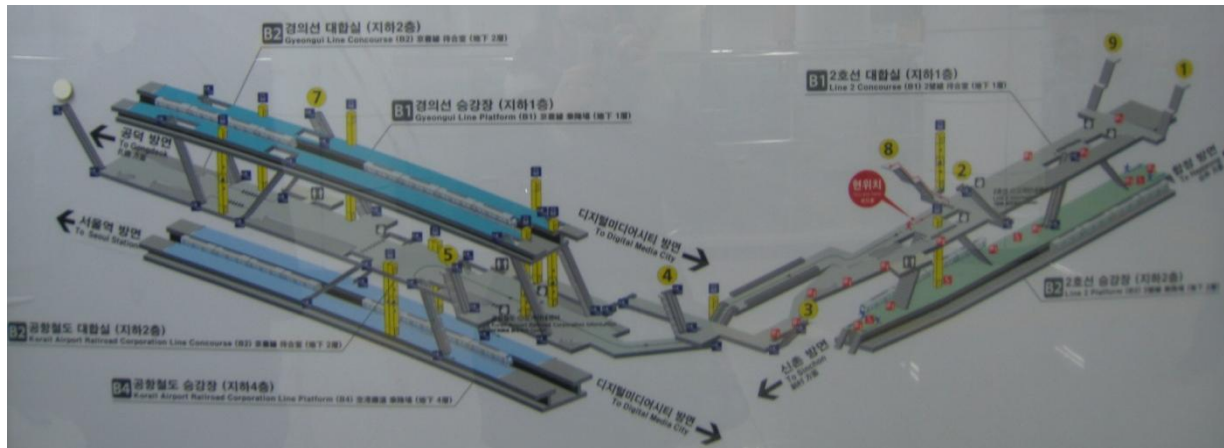Via Michelin

RouteNet

OpenRouteService

1. Use of indoor data

Multimodal example

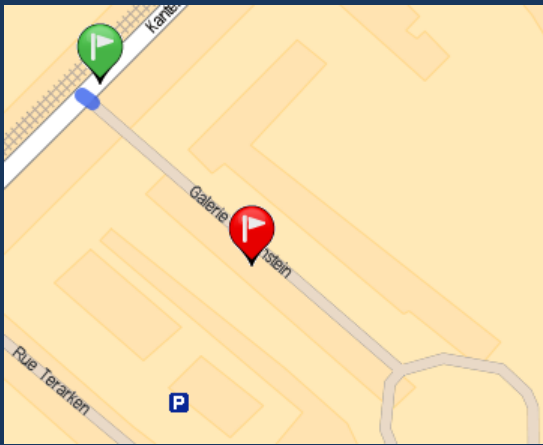Naver

Google Maps

1. Use of indoor data

Points learned

- Mostly no incorporation of indoor infrastructures
  → Lack of available indoor data
  - Data gathering
  - Geographical area of the query
  - Commercial value
- Available indoor data: differences in LoD
- Underground structures
- 3D indoor data
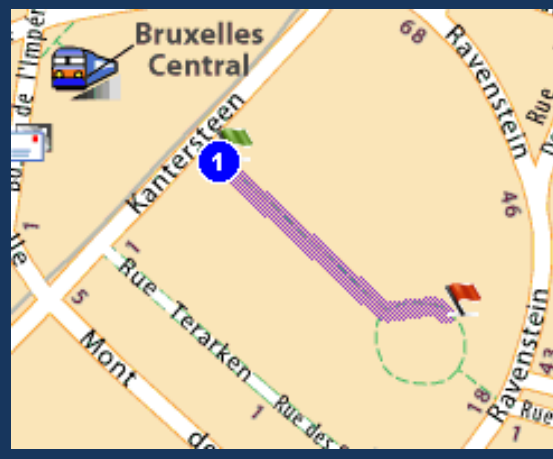
2. Indoor address matching
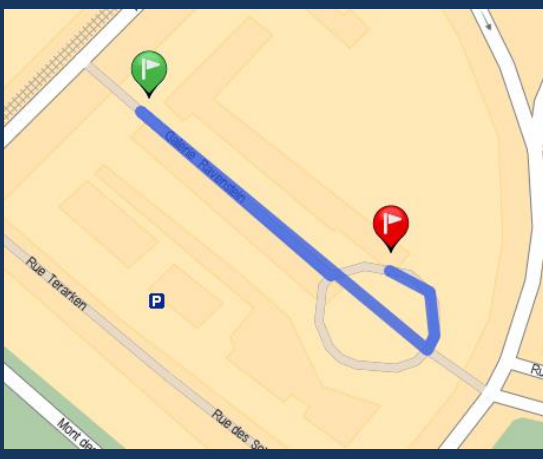
Indoor localisation

Mappy	Via Michelin	RouteNet
	It is not possible to calculate the route because the route planner maps the departure and arrival locations on the same location.	

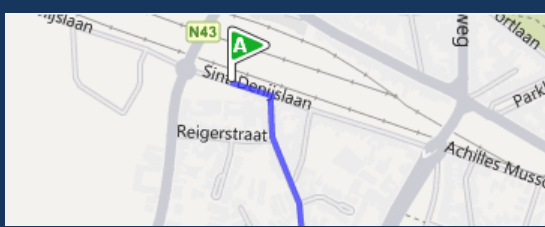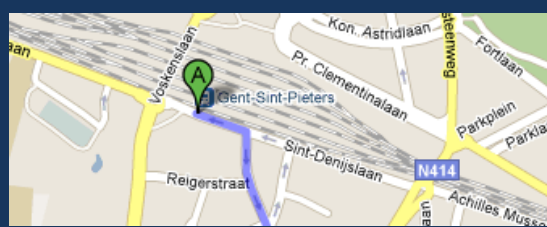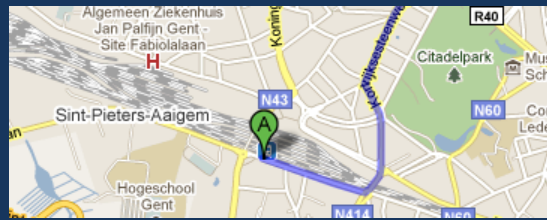# 2. Indoor address matching

Influence on exit choice

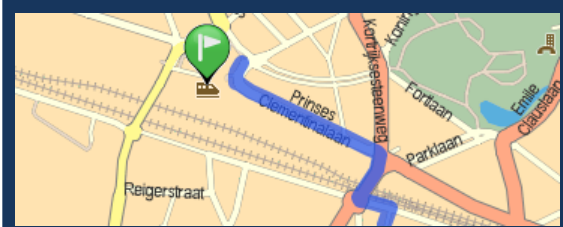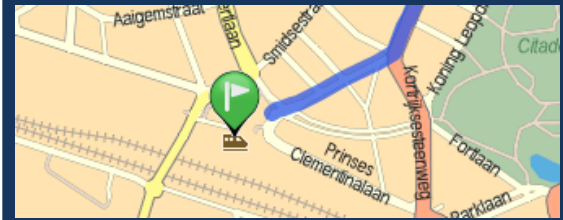# 2. Indoor address matching

Points learned

Both indoor and outdoor problem

- <u>Outdoor:</u> suboptimal routing
  - link address to single exit/entrance point
  - not accounted for destination of query

- <u>Indoor:</u> network information available
  - lineair interpolation on network
    - → partly correct if on different edges
  - projection on outdoor network
  - unable to calculate

Product-to-market implications

Is it feasible to integrate indoor with outdoor navigation?

Data acquisition, standards and accuracy

Indoor geocoding challenges

Product-to-market implications

Data acquisition, standards and accuracy

- <u>Raw data acquisition:</u>
  - no aerial images, mobile mapping
  - many existing internal data from various sources and applications → diversity in quality, coverage, structure, …
  - no standard for indoor data (under development)

- <u>Network transformation:</u>
  no mathematically sound framework

Product-to-market implications

Indoor geocoding challenges

= assigning geographical coordinates to certain input source (e.g. postal addresses)

Requirements

- input source
- reference data set (e.g. Tiger)
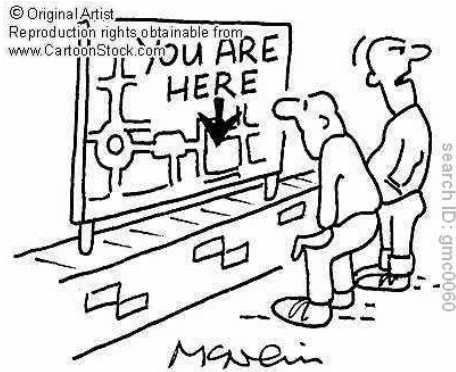- processing algorithm (e.g. linear interpolation)
- required output

Problems

- non-existing uniformity in indoor addressing
  → different processing methodology
- no appropriate and reliable reference data set

Conclusion

Feasibility of integration

- No complete data gathering feasible
  - 3D aspect
  - public participation
  - existing indoor information
- Improved geocoding methodologies
- Full navigation system: positioning techniques

Thank you for your attention