Intermodal Rail Access

Implementation, Calibration, Application

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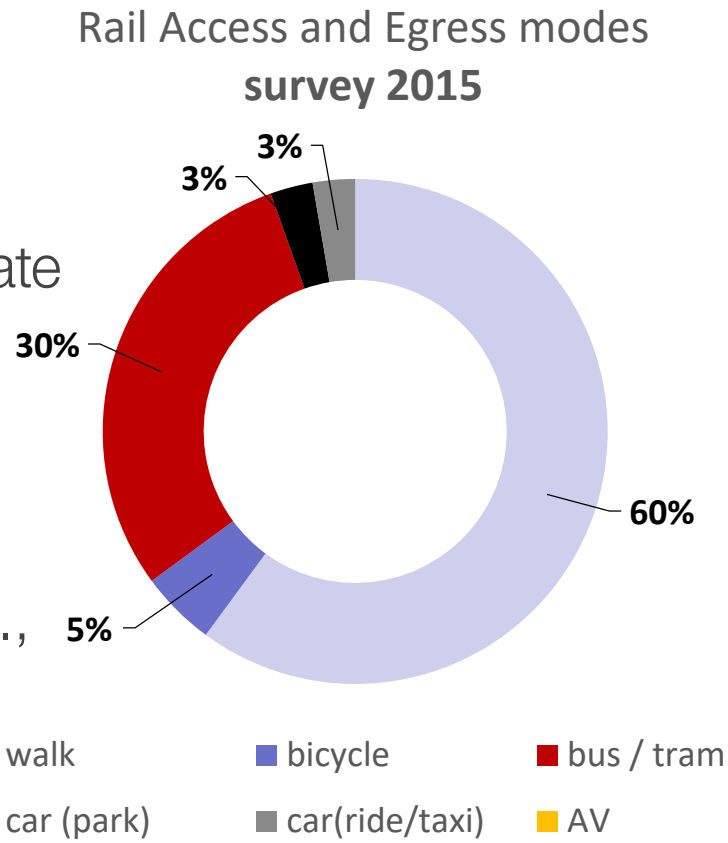
Introduction

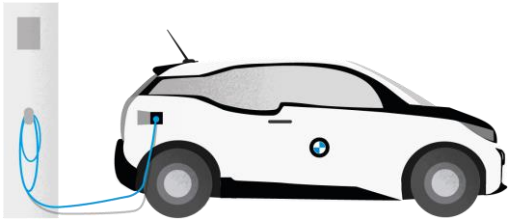
- SIMBA MOBi, including MATSim are used at SBB for corporate decision support and planning applications
- Applications focus currently on intermodal travel behavior
  - Bus planning and coordination
  - Non-PT access to train stations (walk, bike, car, …)
  - Dimensioning of P&R facilities and additional services (e.g., battery charging)
  - AV taxis in future scenarios



- Per default, access to pt stops in MATSim is limited to walk
- Raptor Extension for intermodal access has been available for some time
  - Allows very customized integrations
  - Per default uses routing modules of access / egress modes

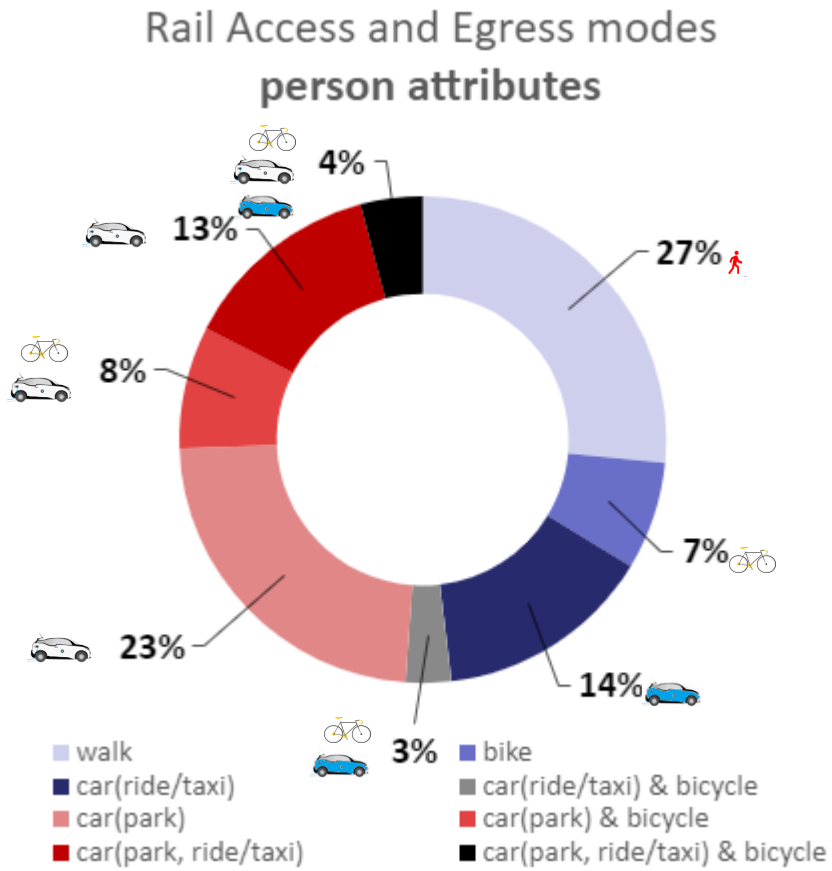
Our requirements and approach

- Must run fast for 1900+ stations and a large search radius (15 km)
- Needs to take street network topology into account
- Should accommodate access, egress and interchange times
  - Parking costs are included
- Access / Egress in MATSim may be teleported
  - Road network and exact location of parking or drop of locations around stations is not always known
  - Avoids possible jamming problems around stations
  - Gives deterministic solution
- Needs to be person-specific



One agent: a chain of options and choices along a tour
Availability of each access mode as an agent attribute

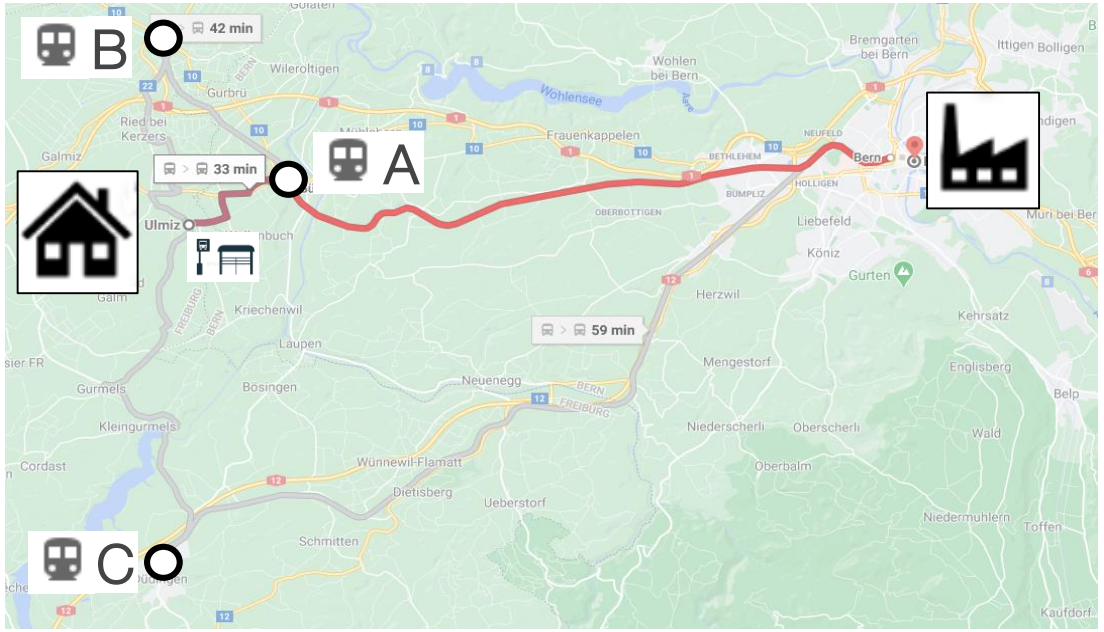
walk	✓
bycicle	✓
Car (drive)	✓
car (ride/taxi)	✓



- A set of intermodal options is randomly given to each agent in the synthetic population, taking into account personal attributes like car availability, age, area type ...

Trip to work
Availability of each access mode at the pt stop

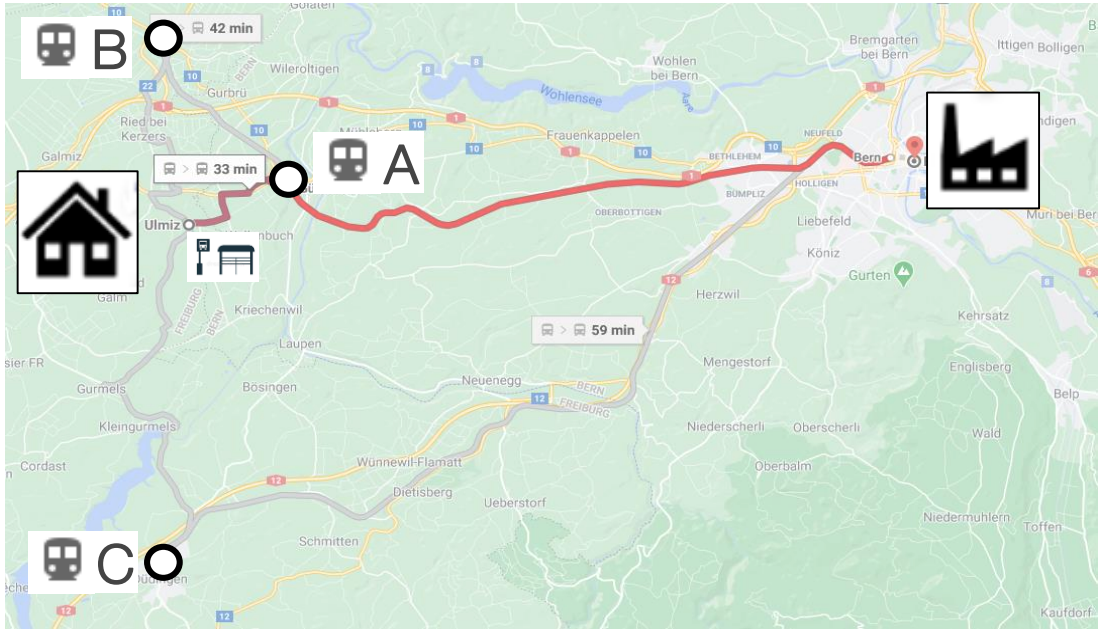
	Bus	A	B	C
walk	✓	✓	✓	✓
bycicle		✓	✓	✓
car (drive)		✓	✓	✓
car (ride/taxi)		✓	✓	✓



- Access to intermodal access can be restricted on the stop level
- MOBi: bike, car and rail are available for all rail stations and selected bus stations

Availability of each access mode: search radius

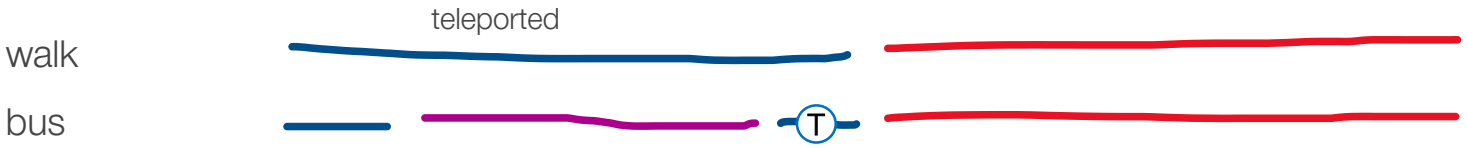
	Bus (100m)	A (3.5 km)	B (6 km)	C (12 km)
Walk (< 3 km)	✓	—	—	—
bycicle (< 4 km)		✓	—	—
car (drive) (<15 km)		✓	✓	✓
car (ride/taxi) (< 15 km)		✓	✓	✓



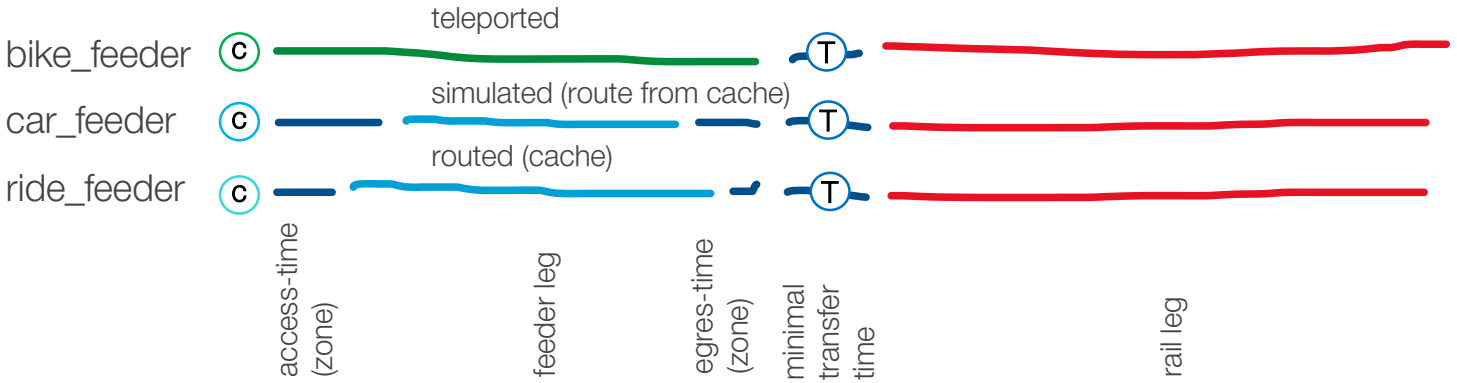
- A search radius can be specified for each access mode
- RandomSelectOneModePerRoutingRequestAndDirection:
  Router gets 1 randomly selected access/egress mode + walk as options

Alternative intermodal paths in PT routing and scoring

Alternative routes without intermodal rail access



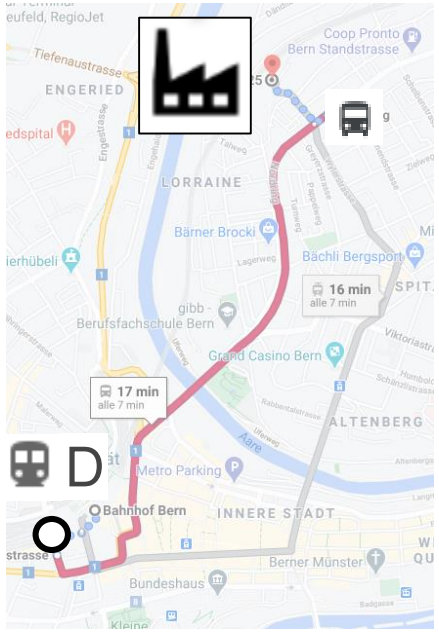
Additional alternatives with intermodal rail access

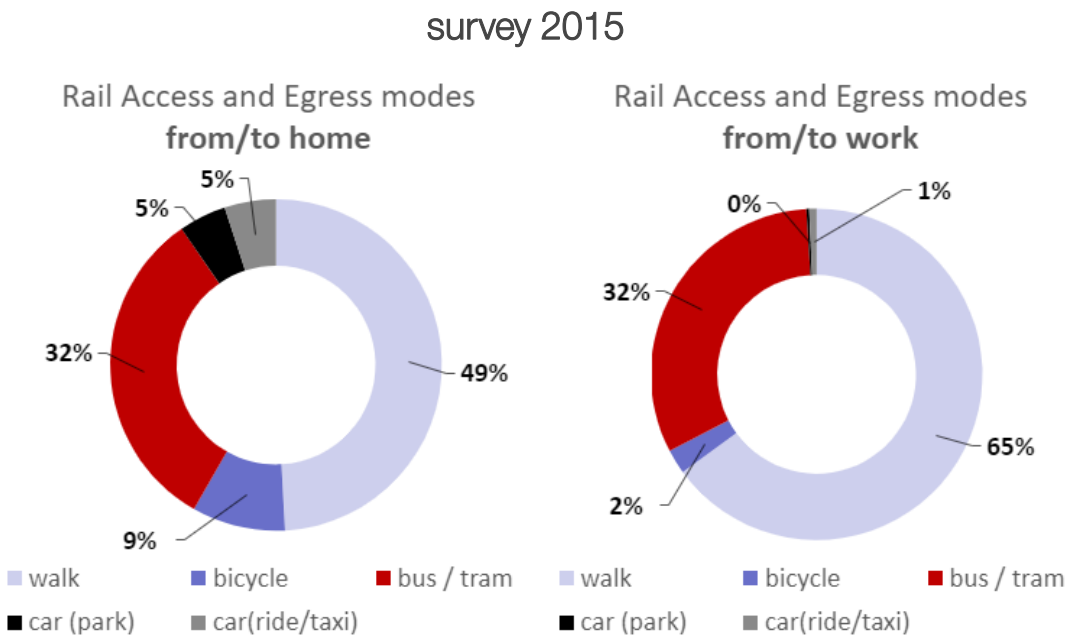


- scoring: started with same marginalUtilityOfTraveling as base mode
- constant for additional feeder modes

Restrictions by activity at the trip end (non-home restriction)

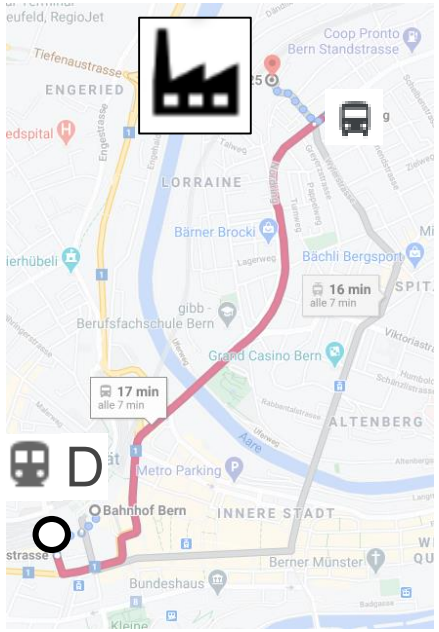
	Bus (50m)	D (2 km)
Walk (< 3 km)	✓	✓
bycicle (< 4 km)		✓
car (drive) (<15 km)		✓
car (ride/taxi) (< 15 km)		✓

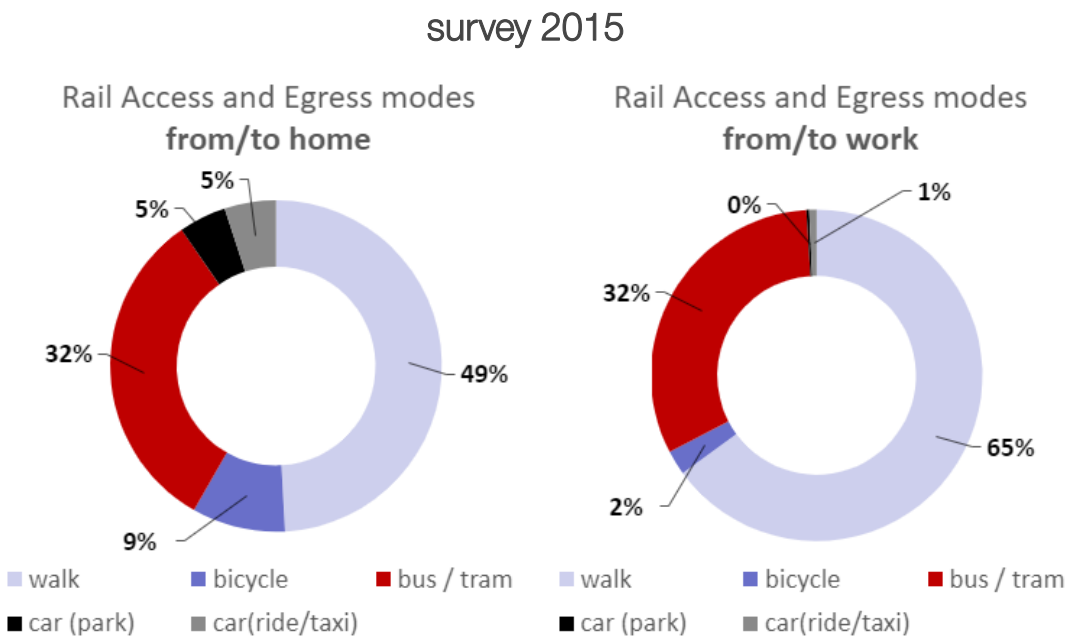




Restrictions by activity at the trip end (non-home restriction)

	Bus (50m)	
Walk (< 3 km)	✓	✓
bycicle (< 4 km)		✓
car (drive) (<15 km)		⛔
car (ride/taxi) (< 15 km)		⛔





- Access to intermodal access/egress for a person can be restricted further depending on the activity at the trip end / start
- This helped a lot to get reasonable mode shares especially in cities

Intermodal Access in SIMBA MOBi
- Important steps on our way

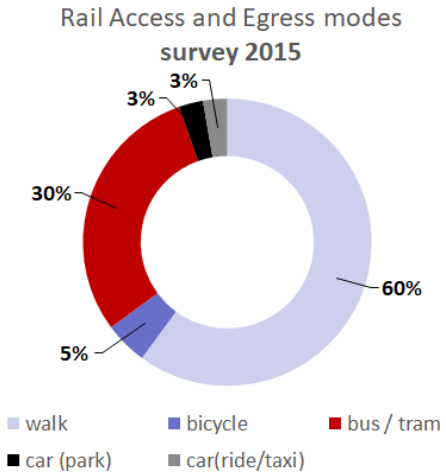
to get access/egress mode shares right

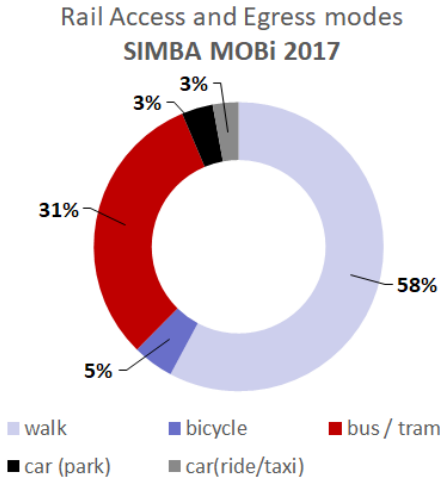
- Access attributes on agent level
- Access attributes on stop level
- Restrictions by activity on the trip end
- Walk is always an option for the router
- Transfer penalty for changing from feeder mode to rail

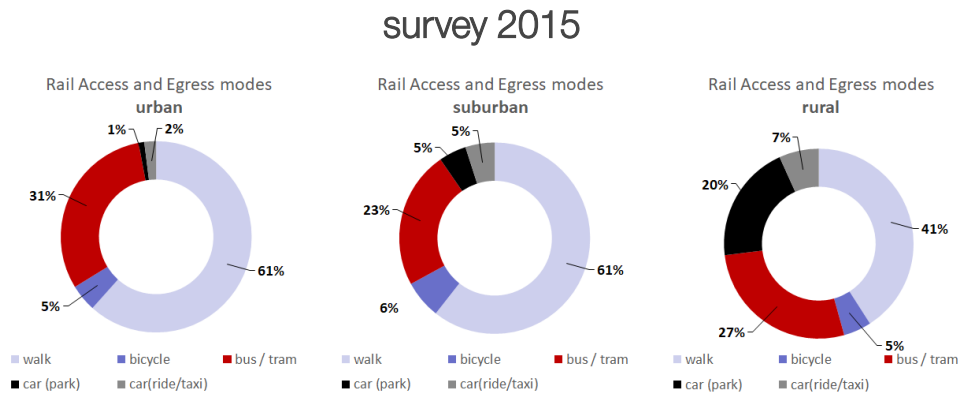
to save computation time

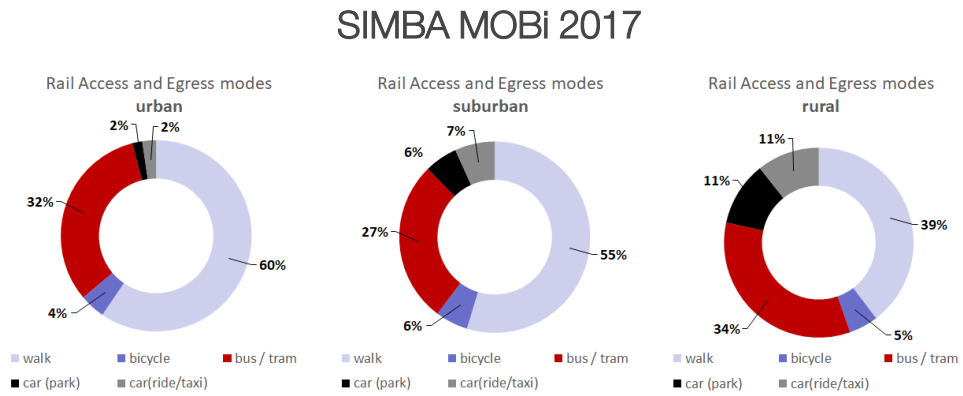
- RandomSelectOneModePerRoutingRequestAndDirection
- Cache access/egress routes for car

Intermodal Access in SIMBA MOBi
- Calibration / Mode shares by land use type









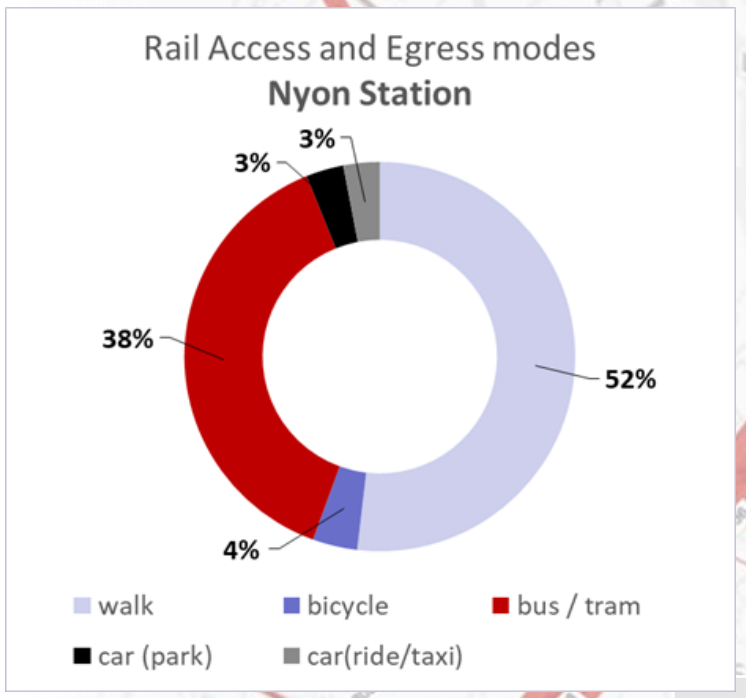
Implementation

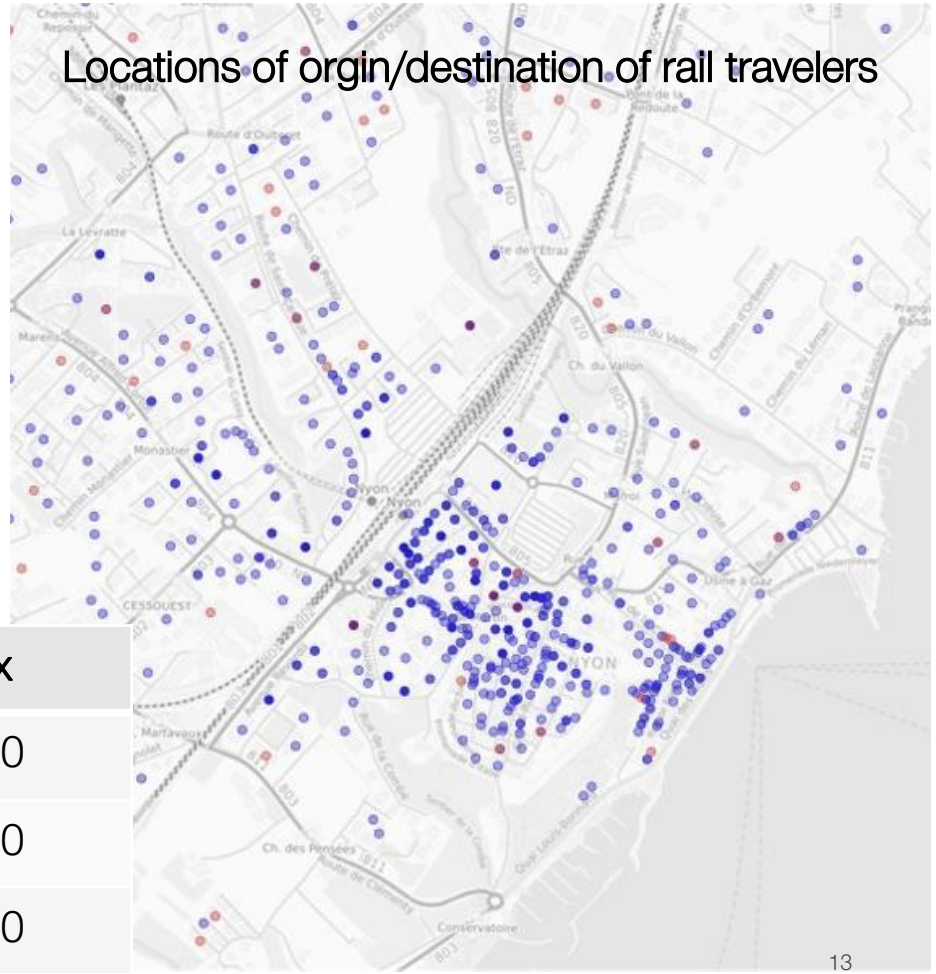
- Implementation via RaptorIntermodalAccessEgress interface
- Travel times for different access modes around stations are cached upon simulation startup based on freespeed travel time estimates
- Access and egress walks are added if required
- Optionally, cache can be stored into a file
- Mode specific configuration via Config Group

- Code available via https://github.com/SchweizerischeBundesbahnen/matsim-sbb

Application: Rail station capacity studies

SIMBA MOBi delivers input data for rail station design

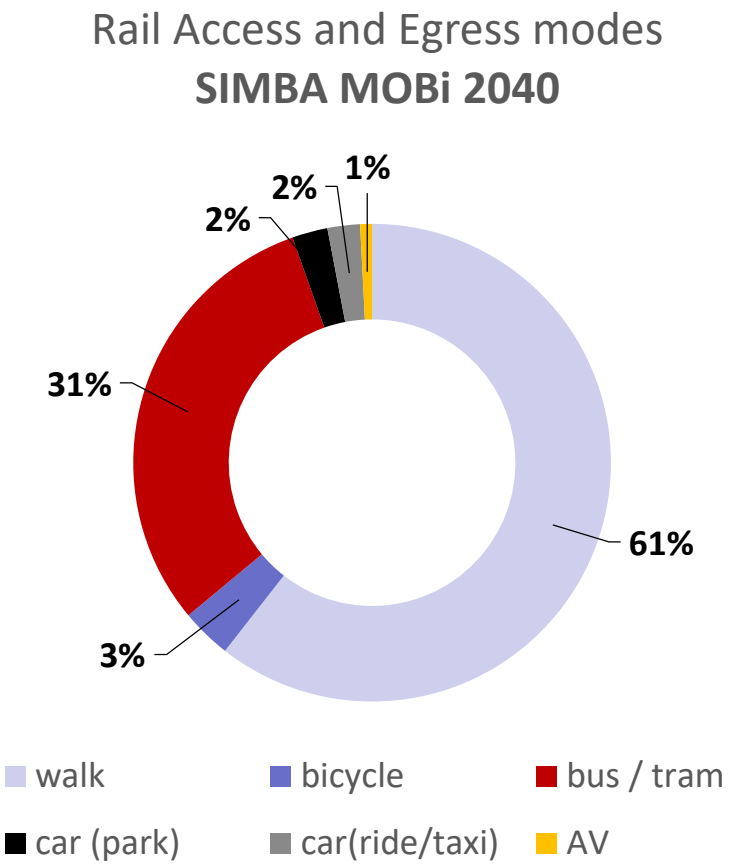




Transfers within the station	Pax
Rail <-> Rail	2500
Rail <-> Bus (stop «centre-ville»)	1500
Rail <-> Bus (stop «gare»)	3700

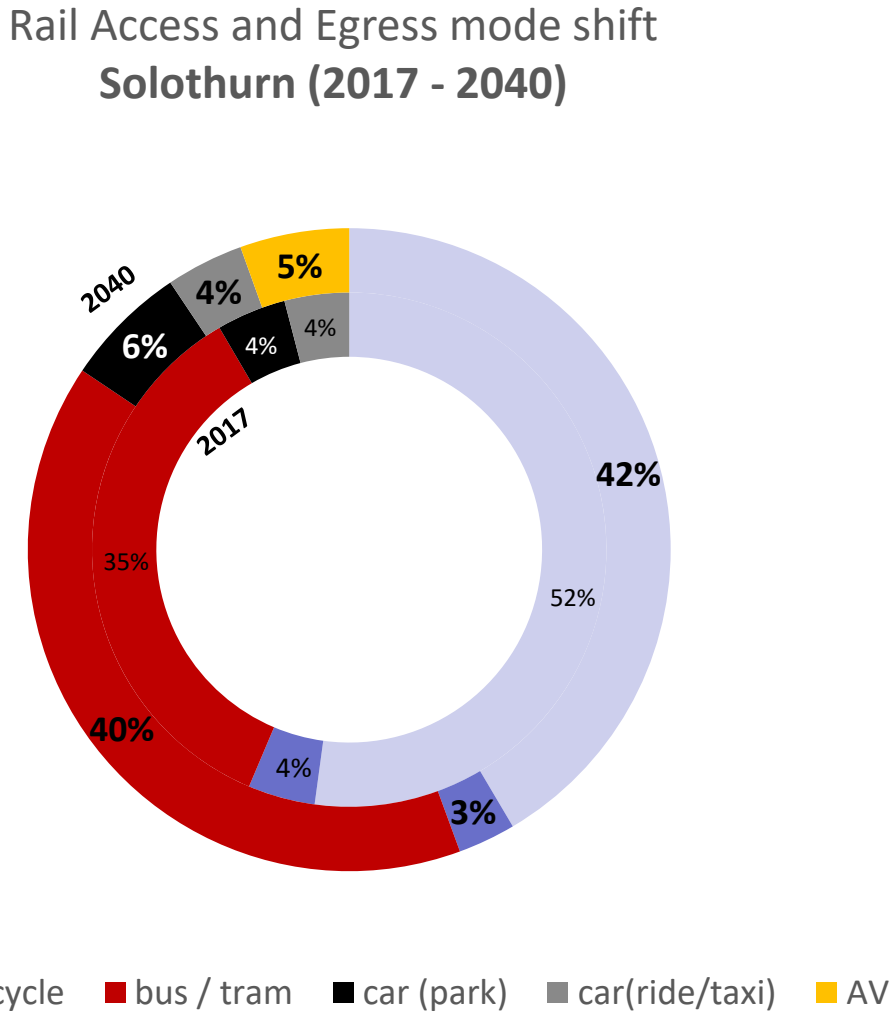
Forecast

- Based on our current model forecast 2040, the nationwide access to and from railway stations will remain rather stable
- AV-Feeder services will initially become relevant at roughly 120 stations
  - AV Feeder is modeled in a similar way as car and ride access modes, including a certain waiting and detour time
- Stations with feeder access are likely to undergo a more drastic change in access and egress



Forecast

- Change in land use, population structure and rail services show an impact at Solothurn station
- Roughly 2’500 AV trips to and from the station will require a solution for pick-up and drop-off locations

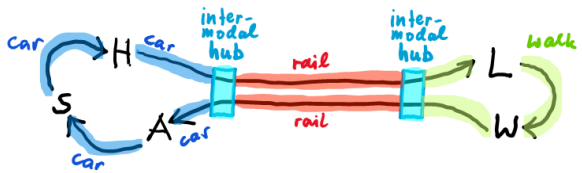


Perspective:
Questions for further research and development

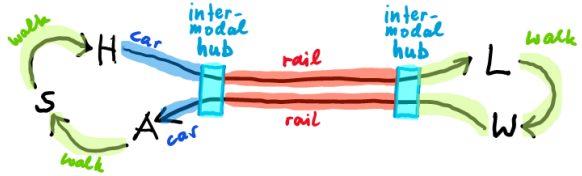
WS

- → **What drives intermodal choices?**
  New survey data covering socioeconomics, mode availability, station infrastructure, time, cost, activities/land use.
- → **How can we measure time and cost for intermodal travel alternatives?**
  Towards mathematical choice models on day plans instead of trips.
- → **Can we simulate consistent vehicle usage along tours in agent-based simulation?**
  From trip-based intermodality to tour-based intermodality.

an agent's tour



Reality



Model today

Thank you for your attention!