Calculation of Skim Matrices Based on MATSim Data

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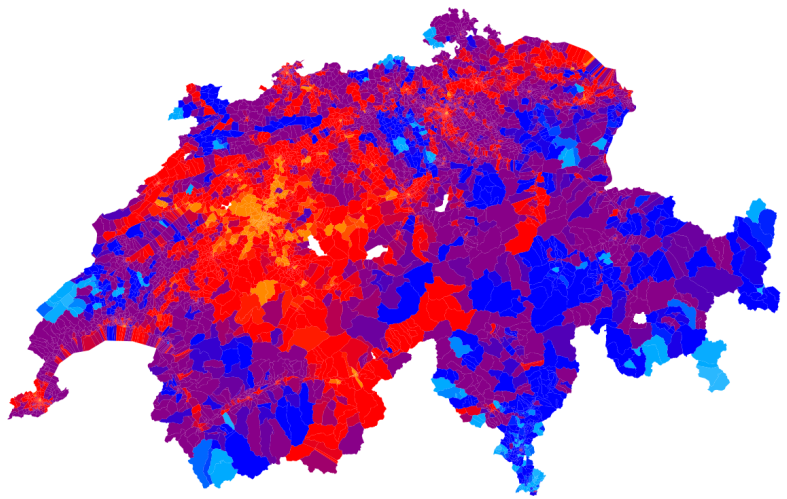
Skim Matrices

Square table with performance indicators for trips between pair of zones.

- travel time (car)
- travel distance (car)
- travel time (pt)
- travel distance (pt)
- fare (pt)
- # transfers (pt)
- # services / hour (pt)
- ...

Used for calculation of demand and destination choice.

	A	B	C	D
A	aa	ab	ac	ad
B	ba	bb	bc	bd
C	ca	cb	cc	cd
D	da	db	dc	dd



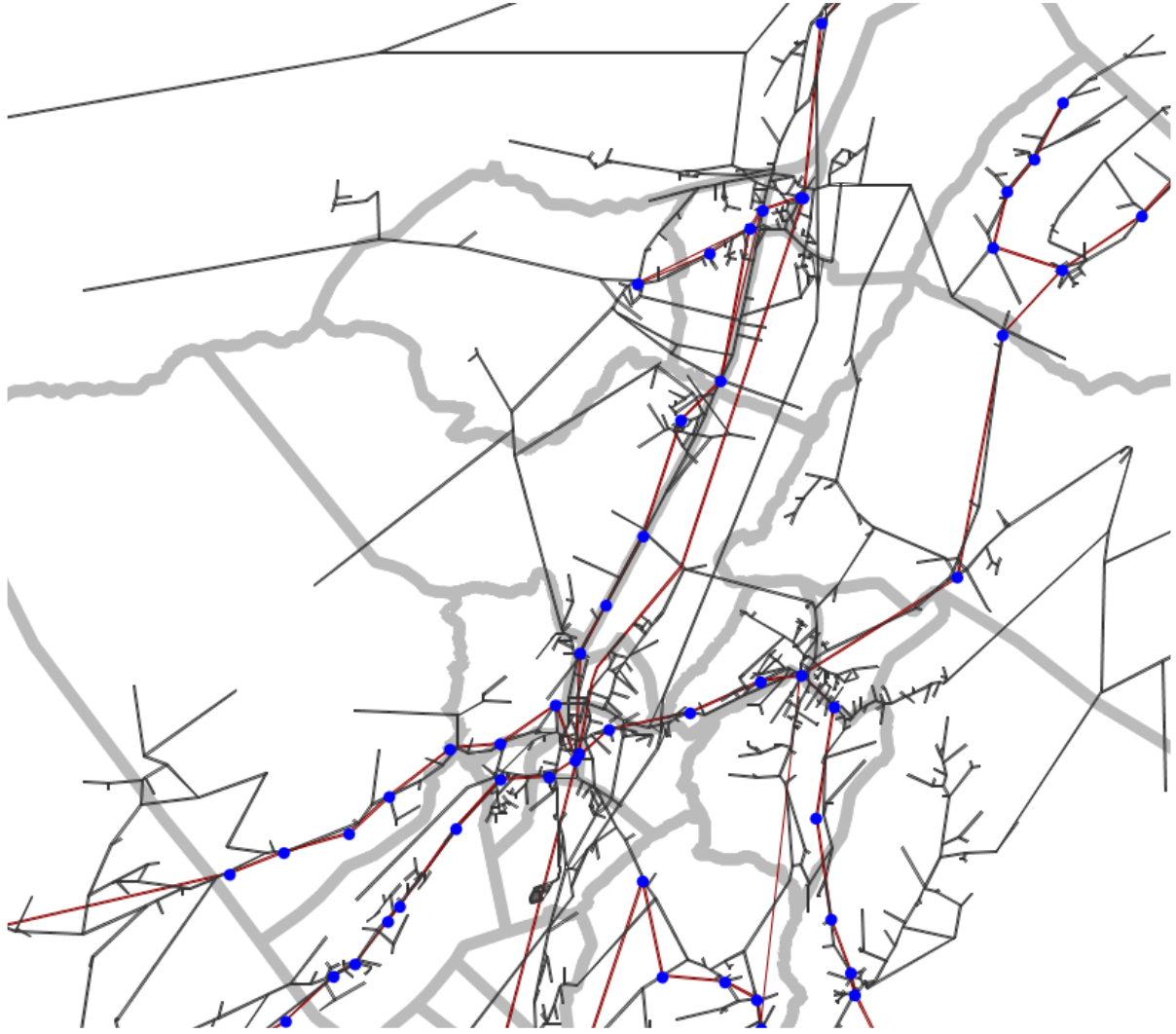
Number of transfers, from Bern: **0** **1** **2** **3** **4**

Calculation of Skim Matrices

MATSim has no zones.

MATSim always calculates specific routes between two locations (transit stops, facilities, coordinates).

→ Aggregations of routes between zones.

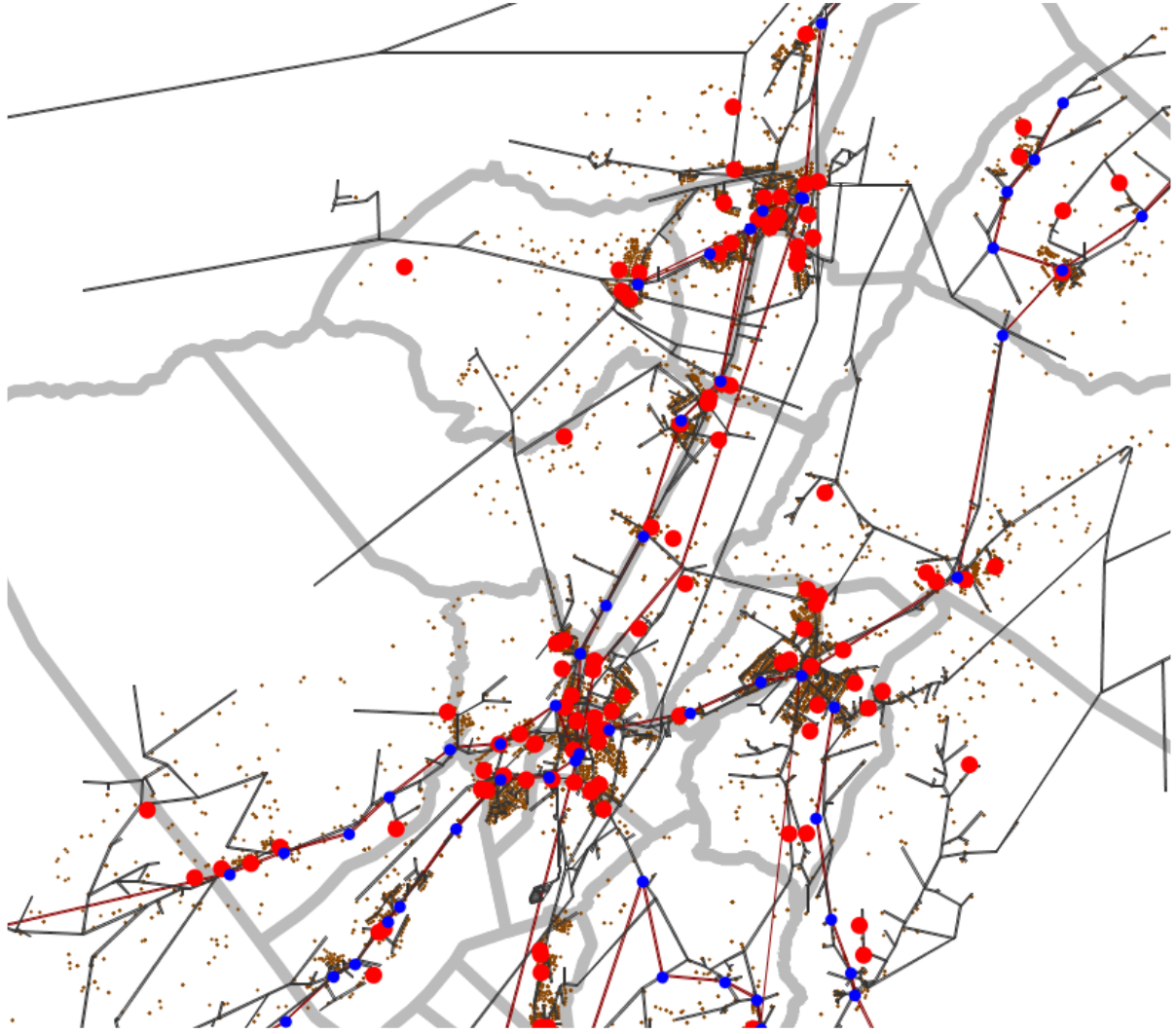


Sampling-Points for Aggregation

Aggregation per OD pair:

- Choose 5 points per zone
- Calculate all 5 × 5 connections between two zones
- Take average of all 25 connections as value for OD pair

Points in a zone are chosen based on (weighted) facility locations.



Calculated Skim Matrices

Public Transport

- access time (from origin to first stop)
- egress time (from last stop to destination)
- travel time (first to last pt stop)
- number of transfers
- perceived service frequency
- average adaption time
- share of rail-based transportation (by distance)
- share of rail-based transportation (by travel time)

Privat Traffic

- travel time
- travel distance

Other

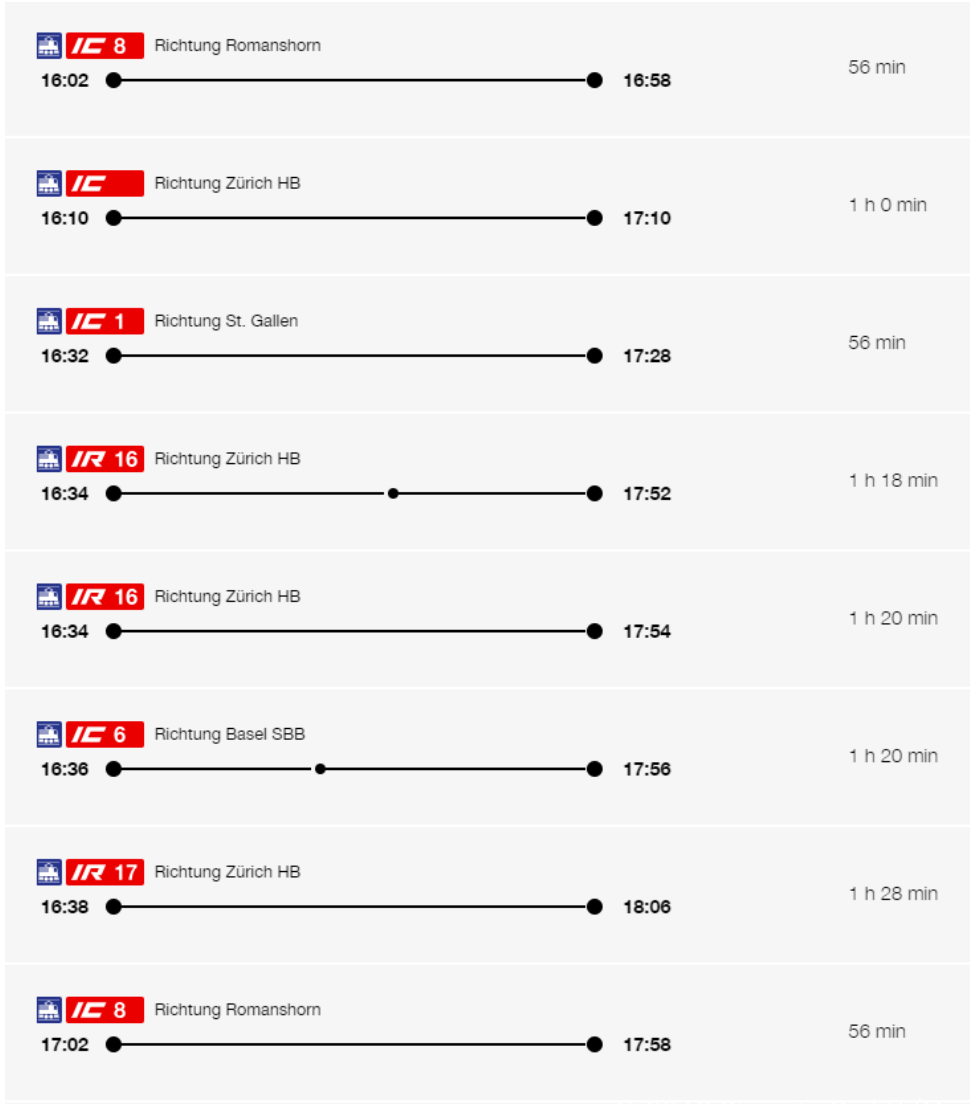
- beeline distance

Perceived Service Frequency

Example:
Travel from Bern to Zurich (Switzerland)

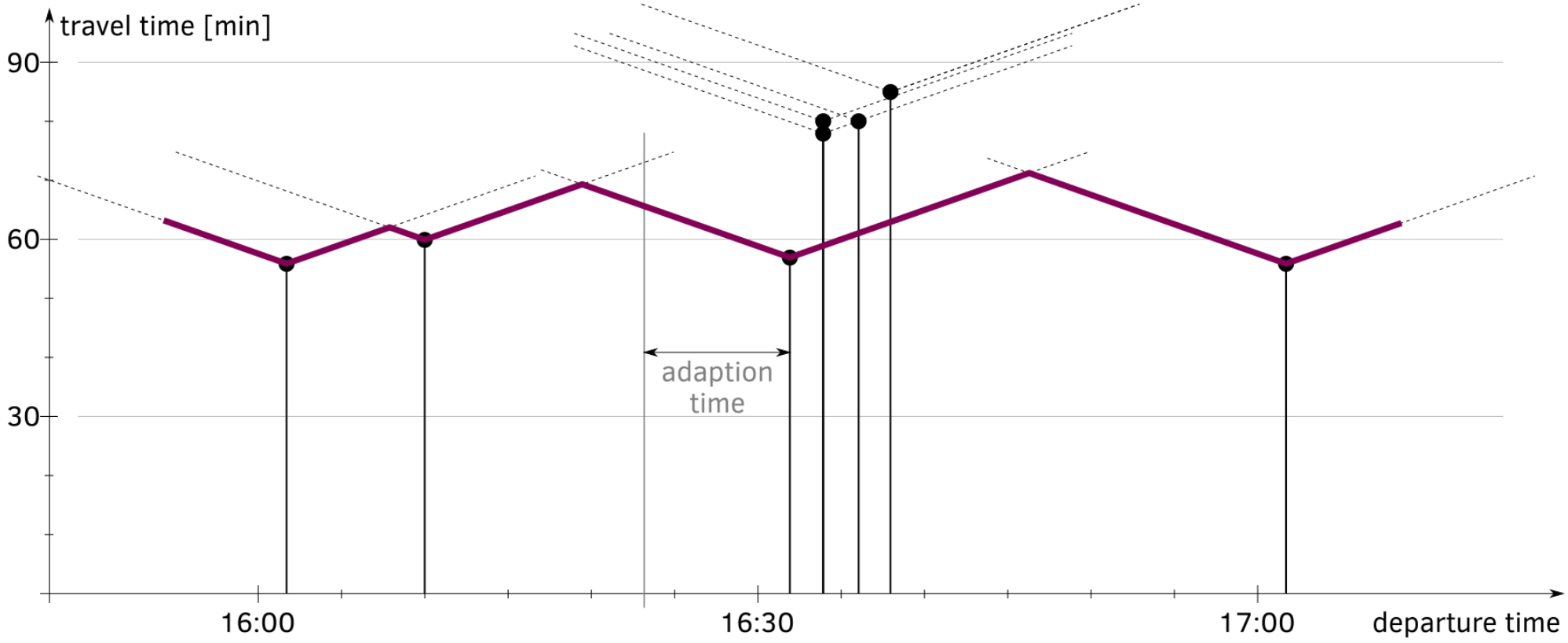
- 7 services per hour?
- 2 (fastest) services per hour?

Calculate average adaption time using **roof-top method**, derive service frequency from average adaption time.



Roof-Top Method to Calculate Average Adaption-Time

Calculate the minimal adaption time (leaving earlier or later) to reach the next best service (by Niek Guis, Nederlandse Spoorwegen)

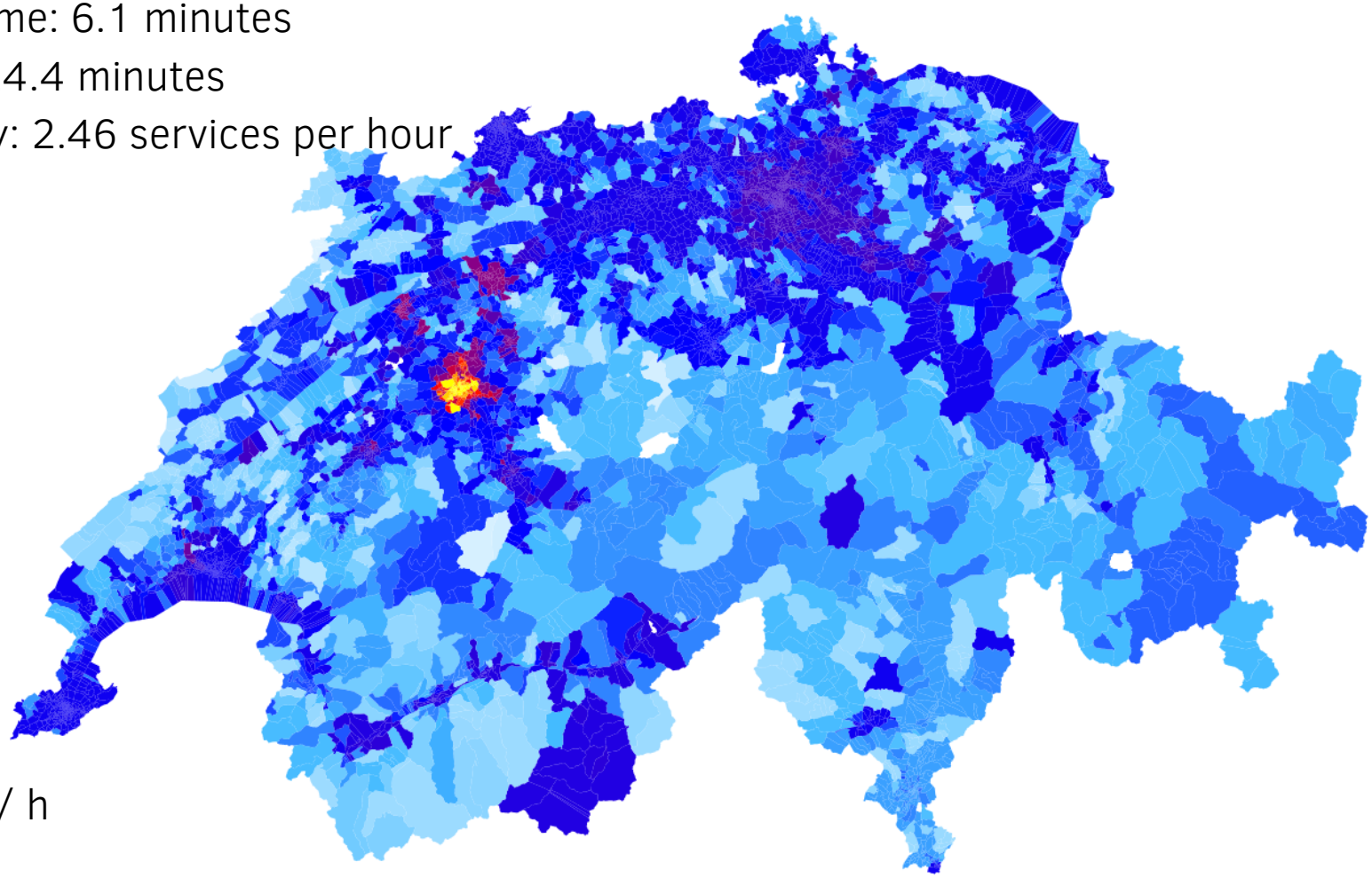


Roof-Top Method: Example

Average Adaption time: 6.1 minutes

Average Headway: 24.4 minutes

Perceived Frequency: 2.46 services per hour



Performance

We need to calculate values for each OD pair, even if there is no demand.

Calculation for Switzerland:

- national transport model: nearly 8 000 zones
- 1 matrix: 8 000 × 8 000 = 64 million values
- each value is average of 25 routes (5 × 5)
- 1 matrix requires **1.6 billion route-calculations**

- Average over multiple time of days (e.g. time-dependent travel times)

Using special algorithms to reduce computational effort (especially least-cost-path trees).

Performance

Calculation for Switzerland:

Computation	Time [h:mm]	Notes
initialization	0:45	
car matrices	8:30	4 time of days, 2:10 for a single time of day
pt matrcies	3:40	departure time window of 1 hour
bee-line matrix	0:02	

Calculation used up to 32 threads and 90 GB of RAM.

Open Source

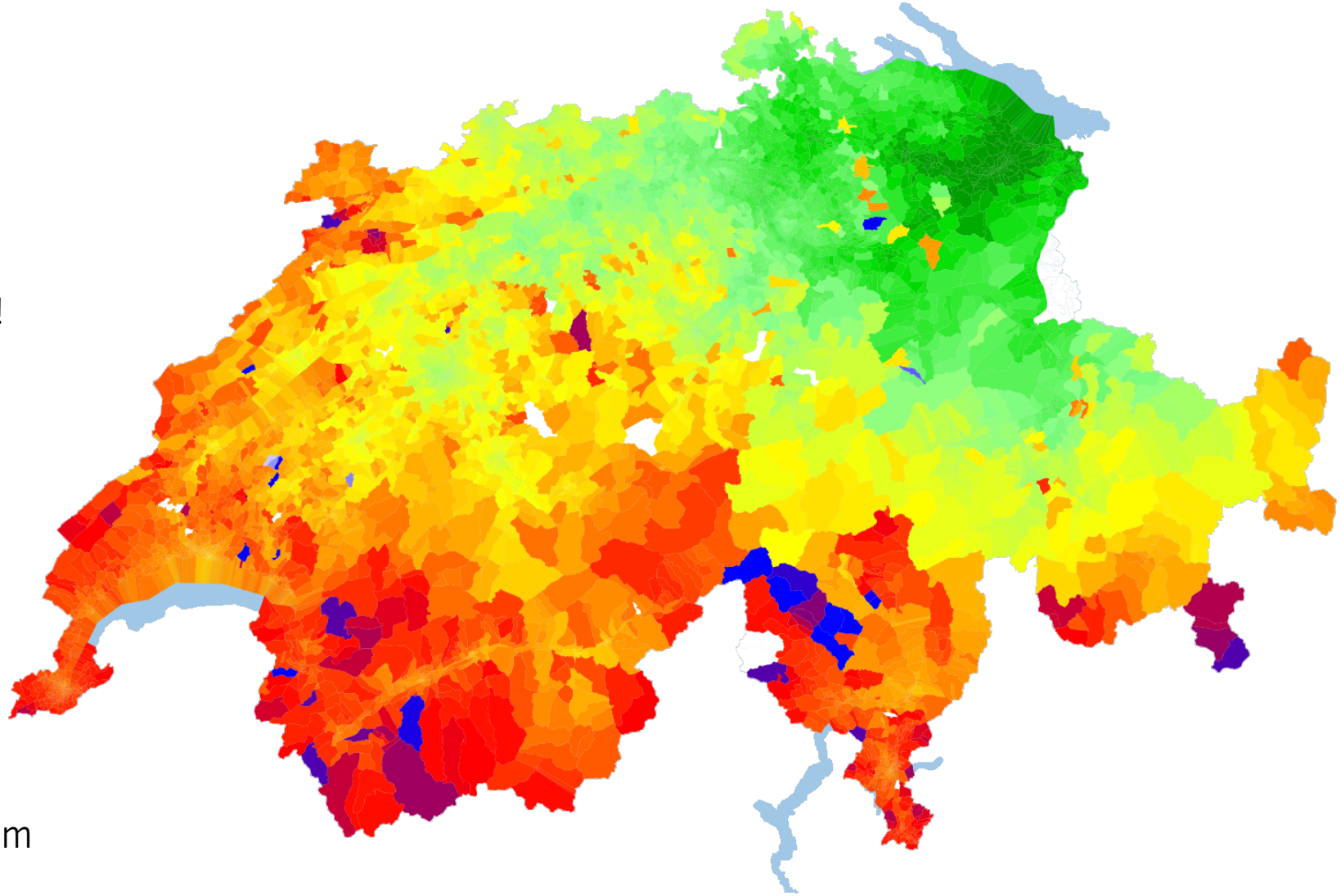
The code is available at:
github.com/SchweizerischeBundesbahnen/matsim-sbb-extensions

(just search for "matsim-sbb-extensions" 😉)

```
CalculateSkimMatrices skims =
    new CalculateSkimMatrices(zonesShapeFilename, zonesIdAttributeName, outputDirectory, numberOfThreads);

skims.calculateSamplingPointsPerZoneFromFacilities(facilitiesFilename, numberOfPointsPerZone, r, facility -> 1.0);

// alternative if you don't have facilities:
// skims.calculateSamplingPointsPerZoneFromNetwork(networkFilename, numberOfPointsPerZone, r);

skims.calculateNetworkMatrices(networkFilename, eventsFilename, timesCar, config, link -> true);
skims.calculatePTMatrices(transitScheduleFilename, earliestTime, latestTime, config, (line, route) -> true);
skims.calculateBeelineMatrix();
```

Thank you!

and thanks to SBB!



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