Accurate High-Performance Route Planning

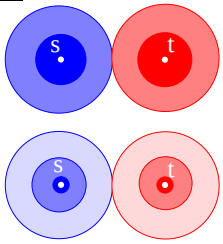
Peter Sanders **Dominik Schultes**

Institut für Theoretische Informatik – Algorithmik II
Universität Karlsruhe (TH)

http://algo2.iti.uka.de/schultes/hwy/

Gouda, July 11, 2006

Our Approach



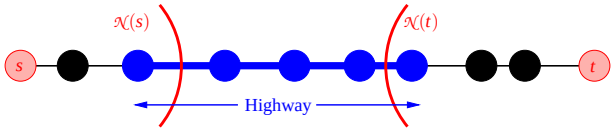
Exact Highway Hierarchy

- complete search in local area
- search in (sparser) highway network
- iterate ⇝ highway hierarchy

Defining the highway network:
minimal network that preserves all shortest paths

- fully automatic (just fix neighborhood size)
- uncompromisingly **fast**

Highway Network



Edge (u,v) belongs to highway network *iff* there are nodes s and t s.t.

- (u,v) is on the "*canonical*" shortest path from s to t

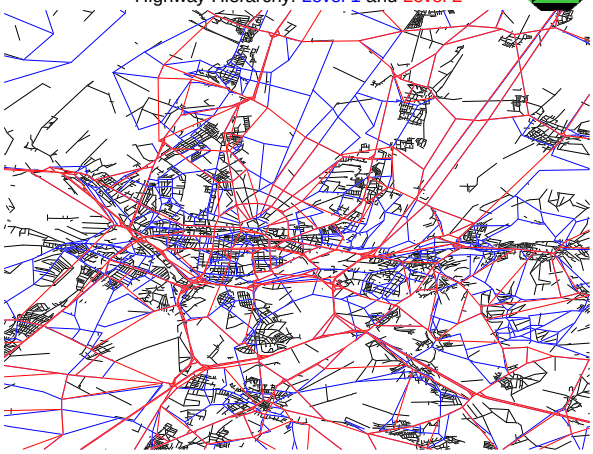
and

- $v \notin \mathcal{N}(s)$

and

- $u \notin \mathcal{N}(t)$

Highway Hierarchy: Level 1 and Level 2



Query

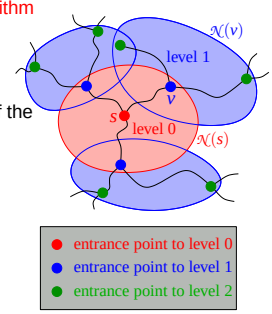
Bidirectional version of Dijkstra's Algorithm

Restrictions:

- Do not leave the neighbourhood of the entrance point to the current level.

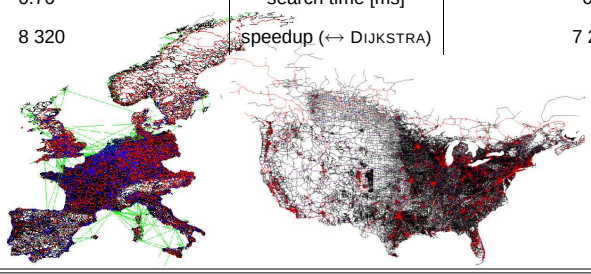
  Instead: switch to the next level.

- Do not enter a component of bypassed nodes.



Experiments

W. Europe (PTV)		USA/CAN (PTV)
18 029 721	#nodes	18 741 705
42 199 587	#directed edges	47 244 849
15	construction [min]	20
0.76	search time [ms]	0.90
8 320	speedup (↔ DIJKSTRA)	7 232



Summary

- exact routes in large street networks e.g. ≈ 18 million nodes
  ⇝ quality advantage, advertisement argument
- fast search < 1 ms
  ⇝ cheap, energy efficient processors in mobile devices
  ⇝ low server load
  ⇝ lots of room for additional functionality
- fast preprocessing ≈ 20 min
- low space consumption ≪ data base
- no manual postprocessing of data
  ⇝ less dependence on data sources
- organic enhancement of existing commercial solutions

Work in Progress

- computation of $M \times N$ distance tables
  joint work with [Knopp, Schulz][1,2]

- combination with a goal directed approach (landmarks)
  joint work with [Delling, Holzer][1]

[1] Universität Karlsruhe, Algorithmics I Group

[2] PTV AG