



# Accurate High-Performance Route Planning

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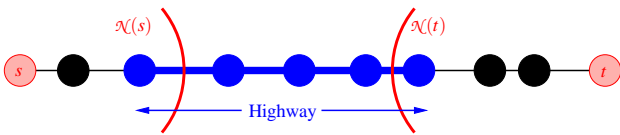
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## Highway Network



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

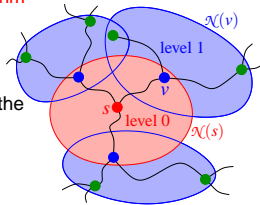


## Query

**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.



- entrance point to level 0
- entrance point to level 1
- entrance point to level 2



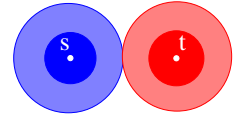
## Summary

- exact routes** in **large** street networks     e.g.  $\approx$  18 million nodes  
 $\rightsquigarrow$  quality advantage, advertisement argument
- fast search**      $\approx$  2.5 ms  
 $\rightsquigarrow$  **cheap, energy** efficient processors in **mobile devices**  
 $\rightsquigarrow$  low **server** load  
 $\rightsquigarrow$  lots of room for **additional functionality**
- fast preprocessing**      $\approx$  30 min
- low space consumption**      $\ll$  data base
- no manual postprocessing of data**  
 $\rightsquigarrow$  less dependence on data sources
- organic enhancement of existing commercial solutions**

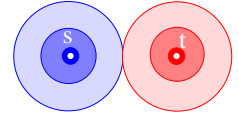


## Exact Highway Hierarchies

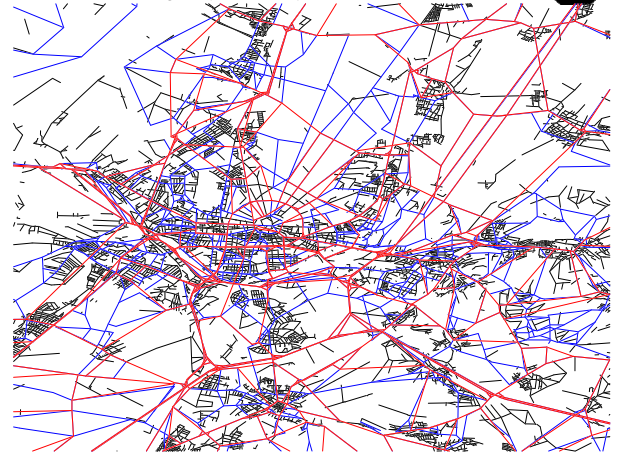
- complete** search within a **local** area
- search in a (**thinner**) **highway network**  
 = **minimal** graph that **preserves** all shortest paths



- contract network, e.g.,
- iterate  $\rightsquigarrow$  **highway hierarchy**

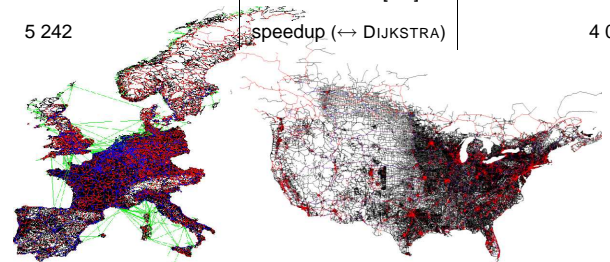


## Highway Hierarchy: Level 1 and Level 2



## Experiments

W. Europe (PTV)		USA/CAN (PTV)
18 029 721	#nodes	18 741 705
42 199 587	#directed edges	47 244 849
21	construction [min]	30
1.94	search time [ms]	2.49
5 242	speedup ( $\leftrightarrow$ DIJKSTRA)	4 021



## Future Work

- combination with **goal directed** approaches
- fast, **local updates** on the highway network  
 (e.g. for traffic jams)
- Implementation for **mobile devices**  
 (flash access ...)
- Flexible objective functions
- ...

