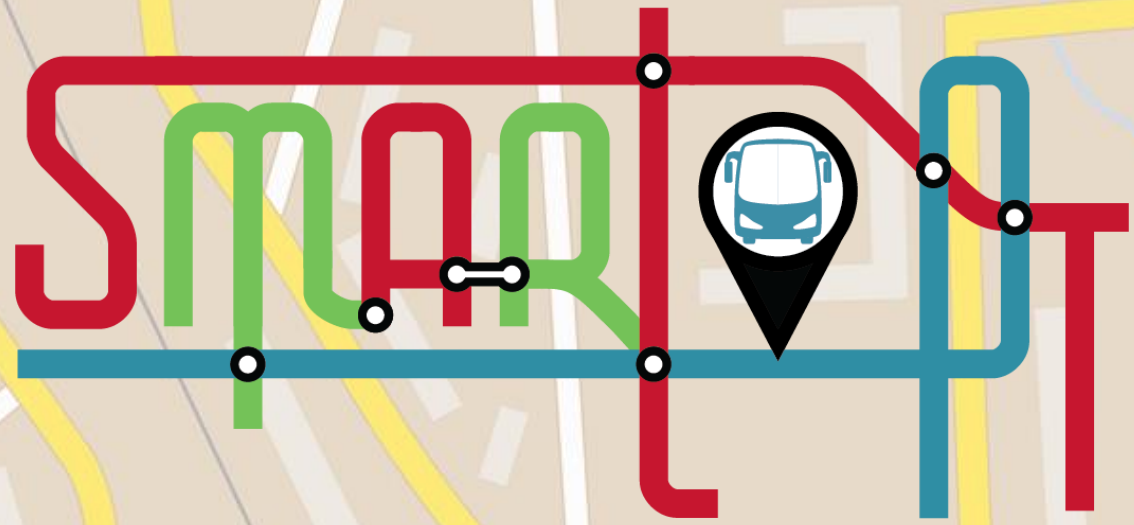

Funded by ERA-NET Transport III
Flagship Call 2013 “Future Travelling”

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Simulation of dynamic transport services

- Design of novel transport services
  - Flexible
  - Demand-responsive
  - Energy/cost efficient
- High complexity
  - Dynamic demand
  - Dynamic supply
  - Dynamic traffic
  - Multi-modality
- Microscopic large-scale simulation needed

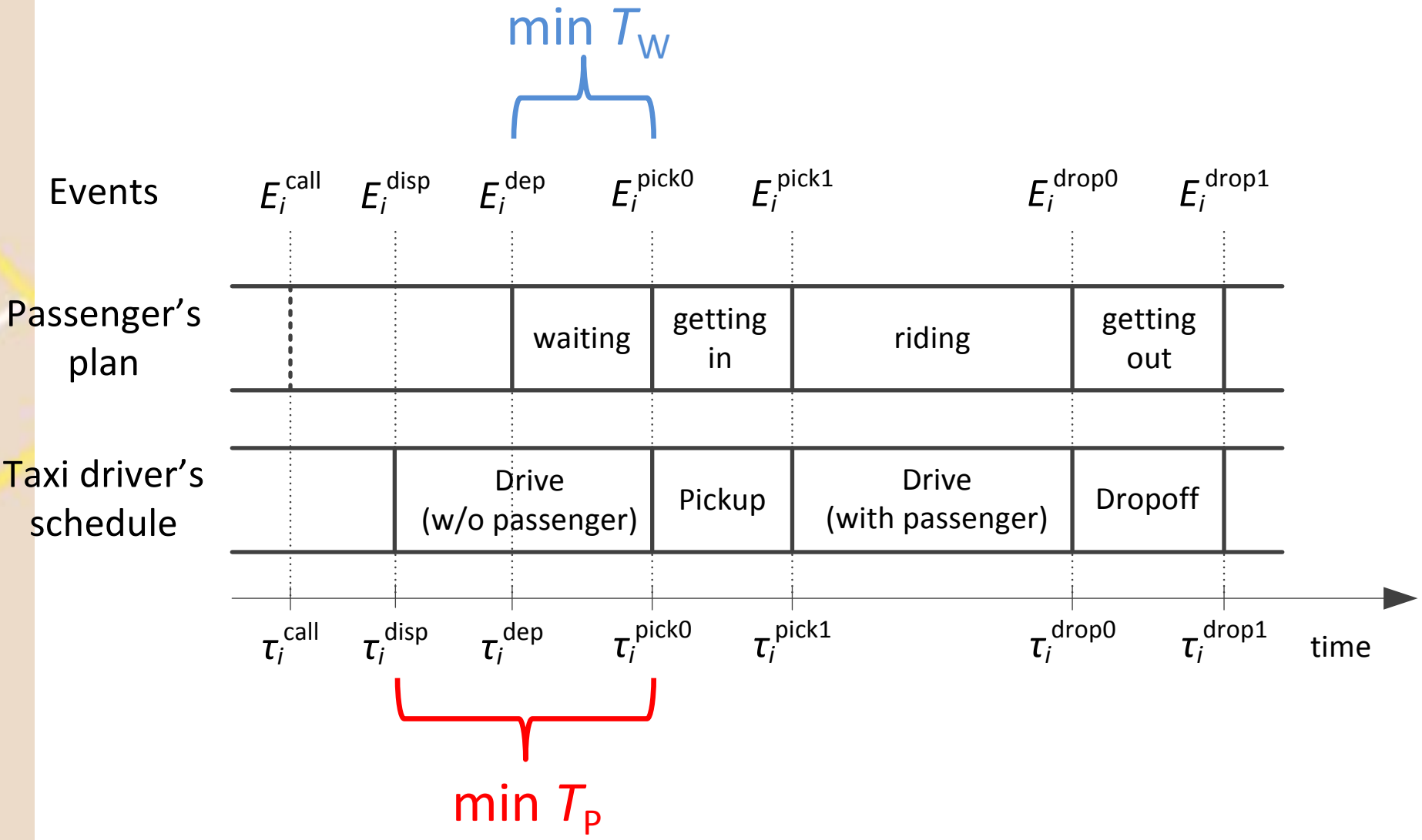
Simulation of dynamic transport services

- MATSim+DVRP
  - Dynamic schedules
  - Fleet included into traffic
  - Online vehicle monitoring
  - Event-driven re-optimization
  - Interaction between the dispatcher, drivers and passengers

Simulation of dynamic transport services

- Applications
  - Taxis (Poznan, Berlin, Barcelona)
  - Demand Responsive Transport (Melbourne, Stockholm, Tel Aviv, Leuven)
  - Autonomous Vehicles (Singapore, Zurich)
  - Personal Rapid Transport (Berlin)

Simulation of taxi services



General assumptions

- Minimize T_W
- Immediate requests
- No knowledge about the future
- Online vehicle monitoring
- Destination *unknown a priori*

Simulation scenario

- Demand: 1, 1.5, …, 4% of 56,000+ trips
- Fleet: 25 cabs
- 6 am – 8 pm

- Traffic at 5 pm

Simple dispatching strategies

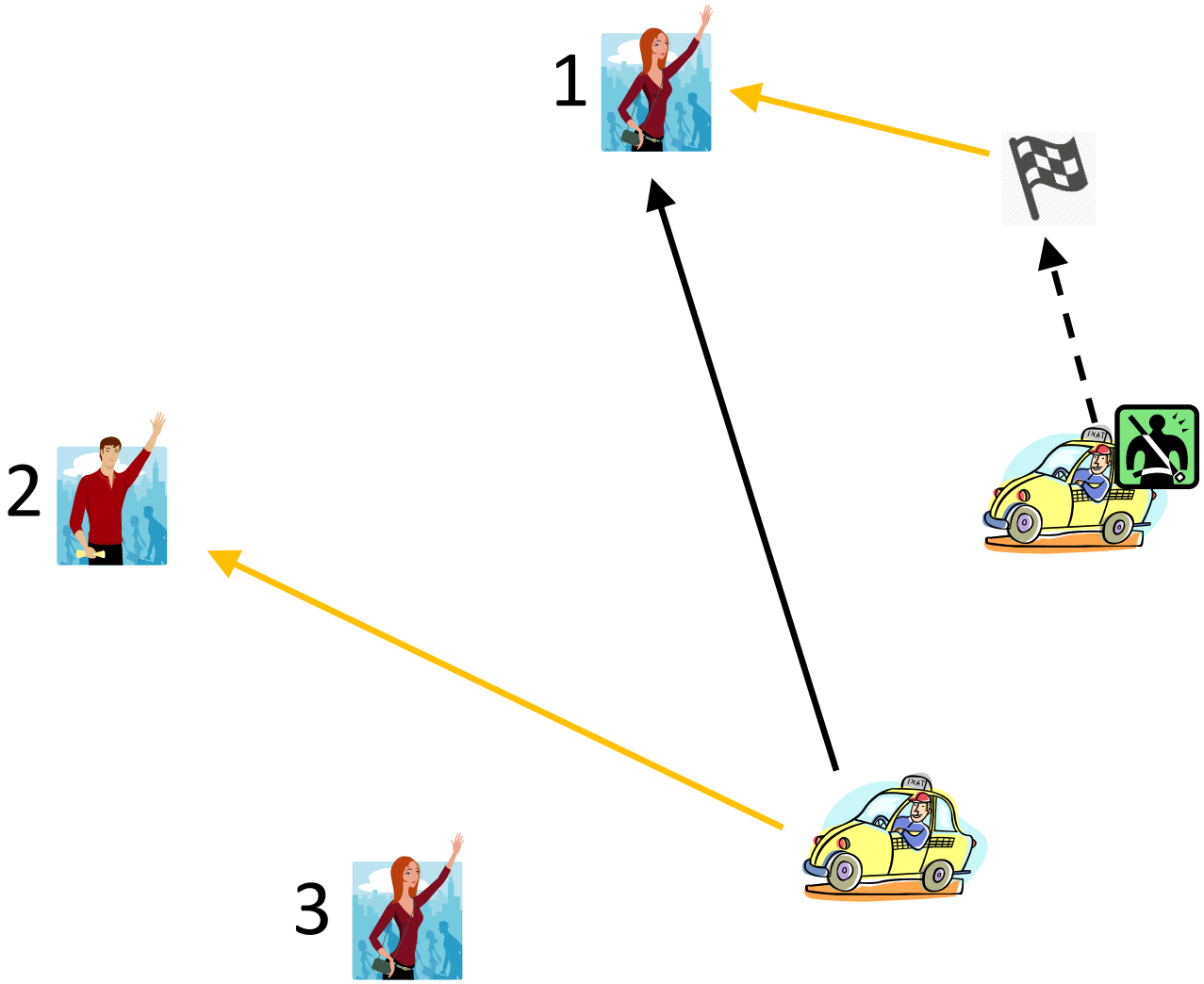
Nearest idle taxi

- taxi call – dispatch the **nearest idle** taxi or queue request
- dropoff – serve the **longest waiting** request or wait

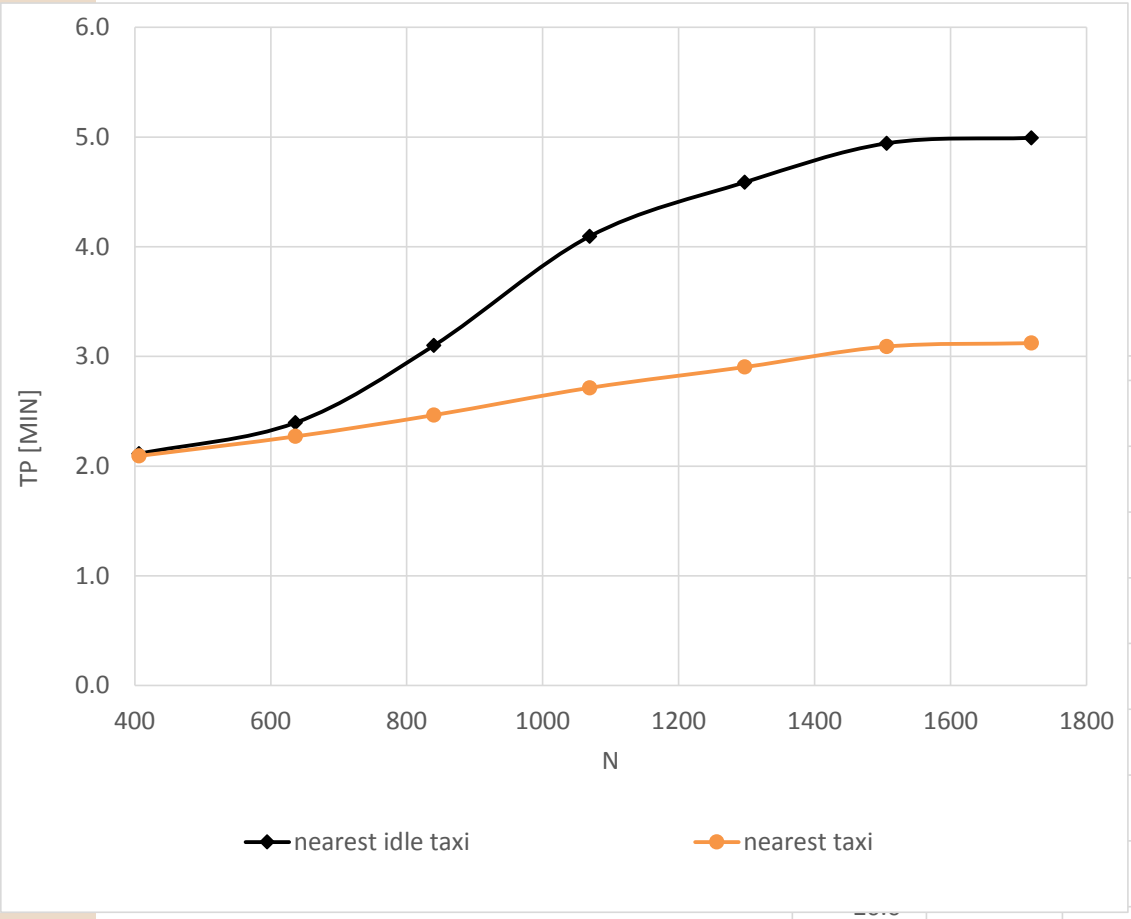
Nearest taxi

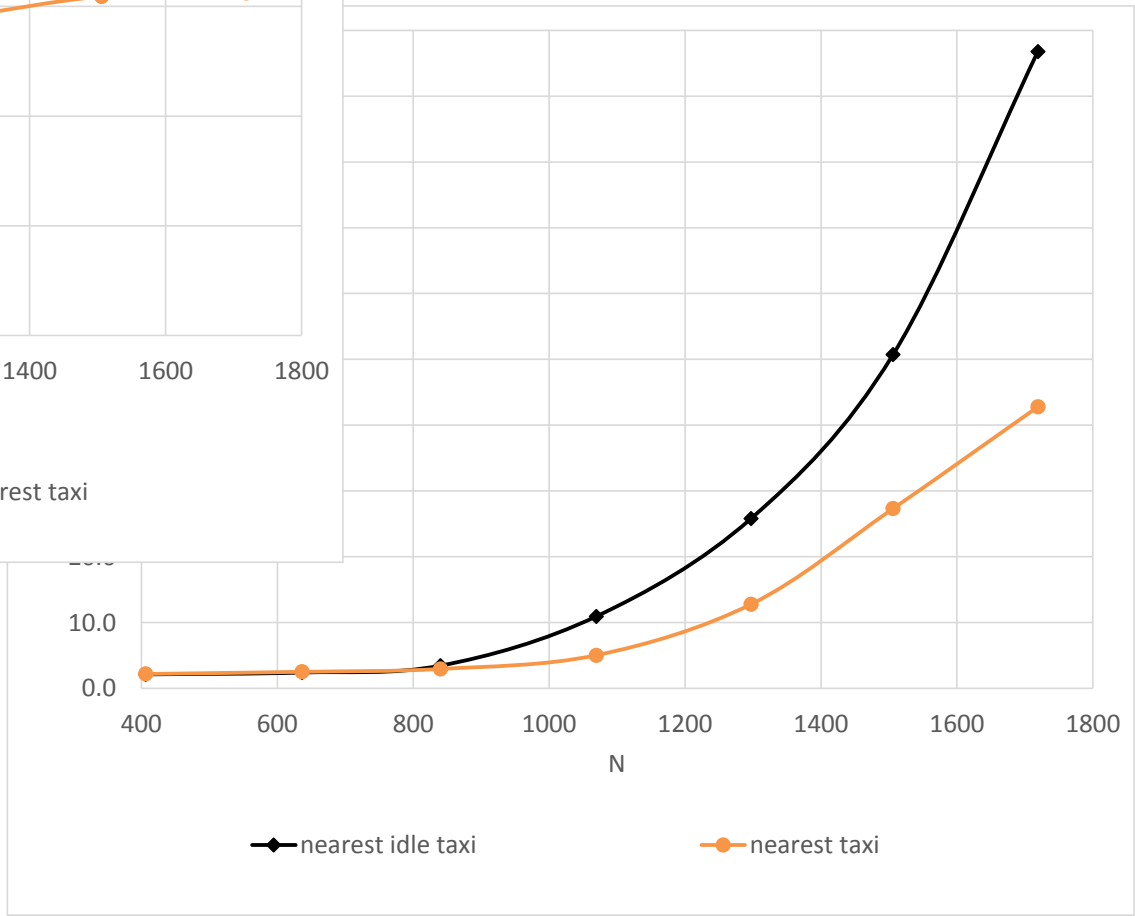
- taxi call – assign the **nearest available** taxi or queue request
- pickup – predict taxi availability, re-assign taxis to awaiting requests (first **longest waiting**)

Simple dispatching strategies



Simple dispatching strategies



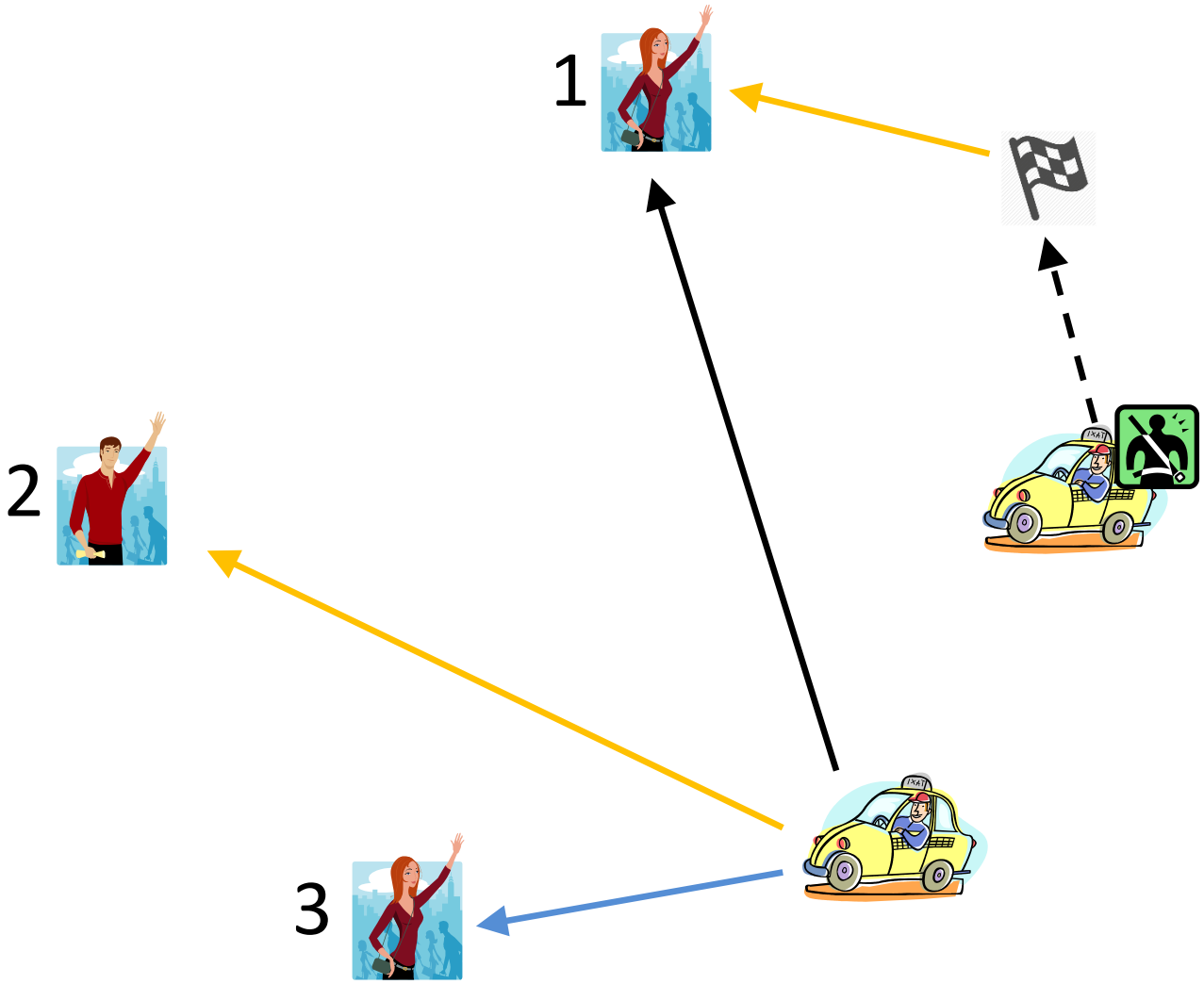


Demand-supply balancing

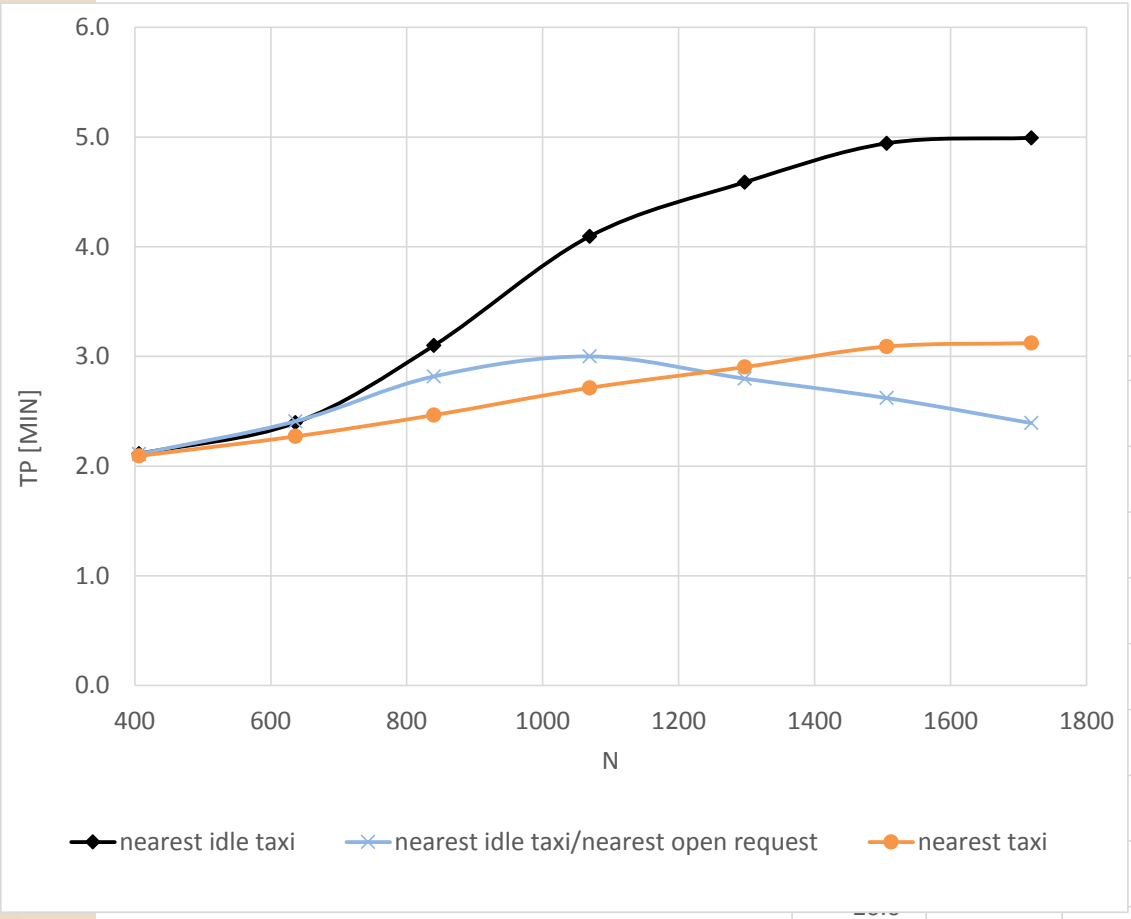
Nearest idle taxi/waiting request

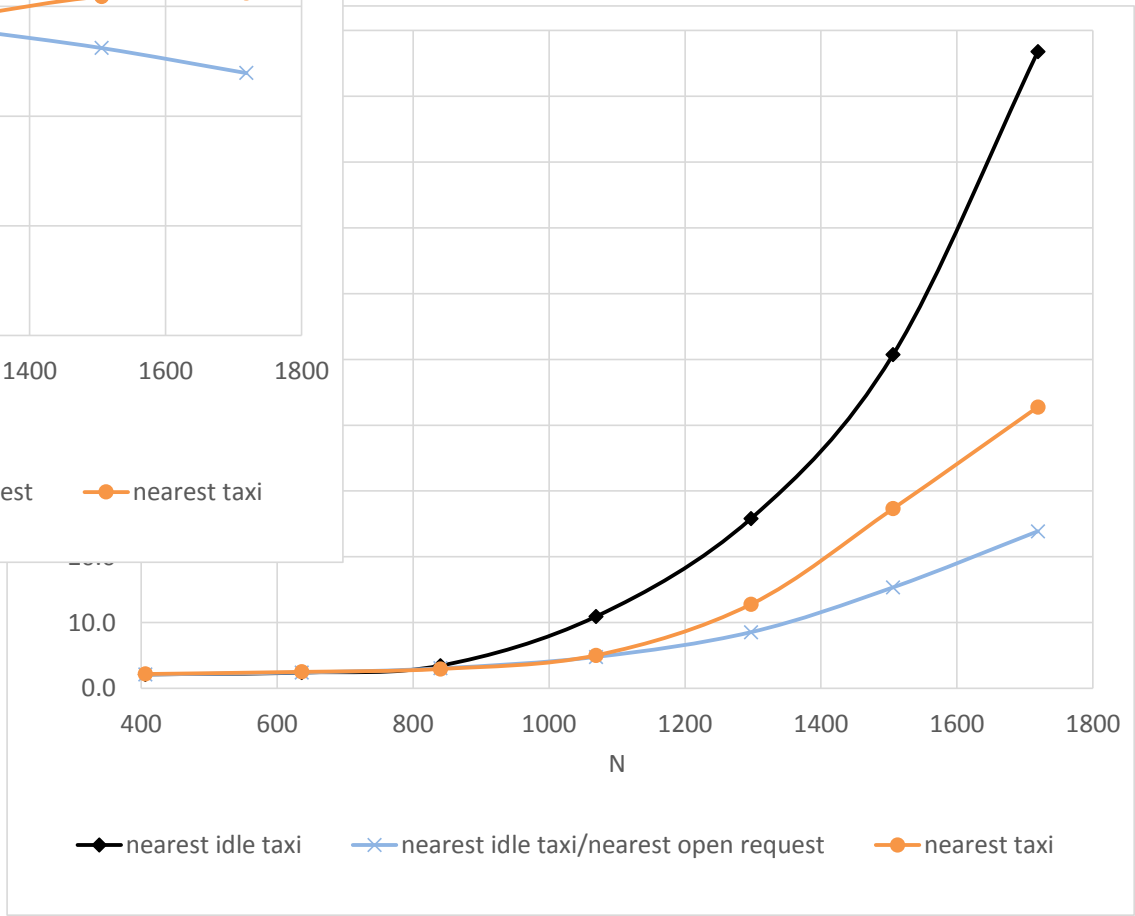
- taxi call – dispatch the **nearest idle** taxi or queue request
- dropoff – serve the **nearest waiting** request or wait

Demand-supply balancing



Demand-supply balancing





Dynamic assignment problem

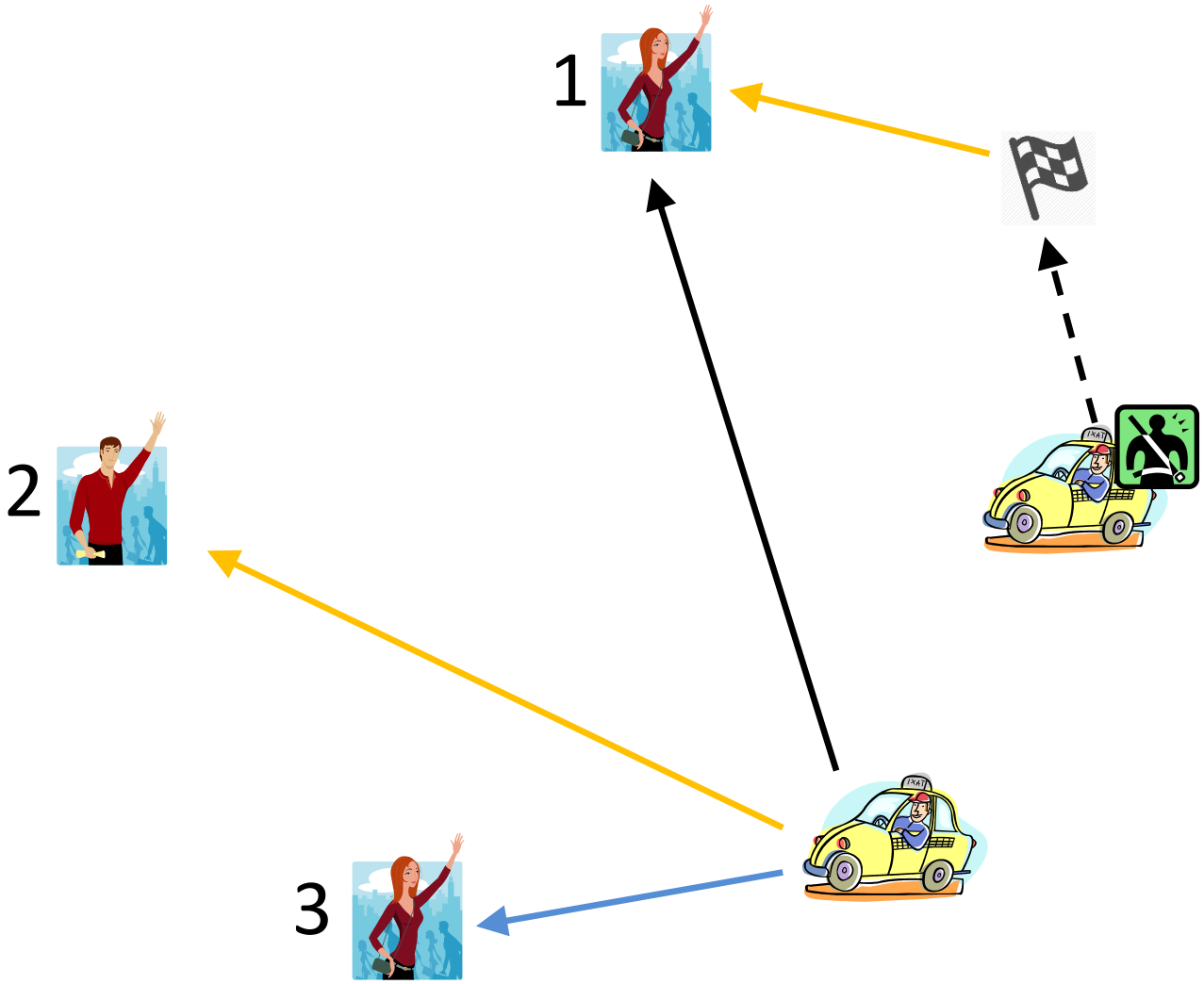
$$c_{ik} = \max\left(a_k, \tau^{\text{curr}}\right) + t_{ki}^{\text{O}}\left(\max\left(a_k, \tau^{\text{curr}}\right)\right)$$

	Waiting requests
Available vehicles	c_{ik}

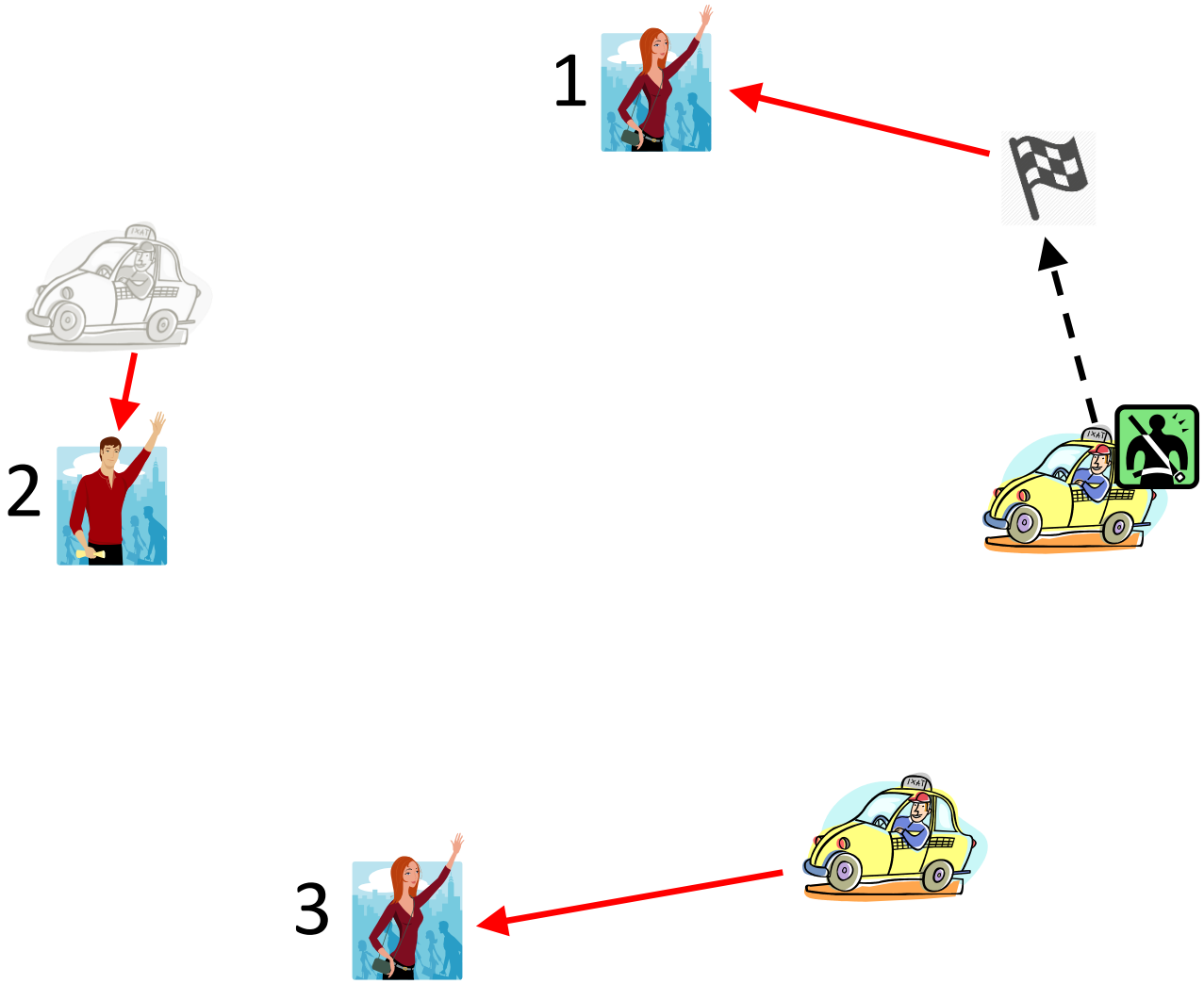
Assignment

- taxi call – solve assignment problem
- pickup – solve assignment problem

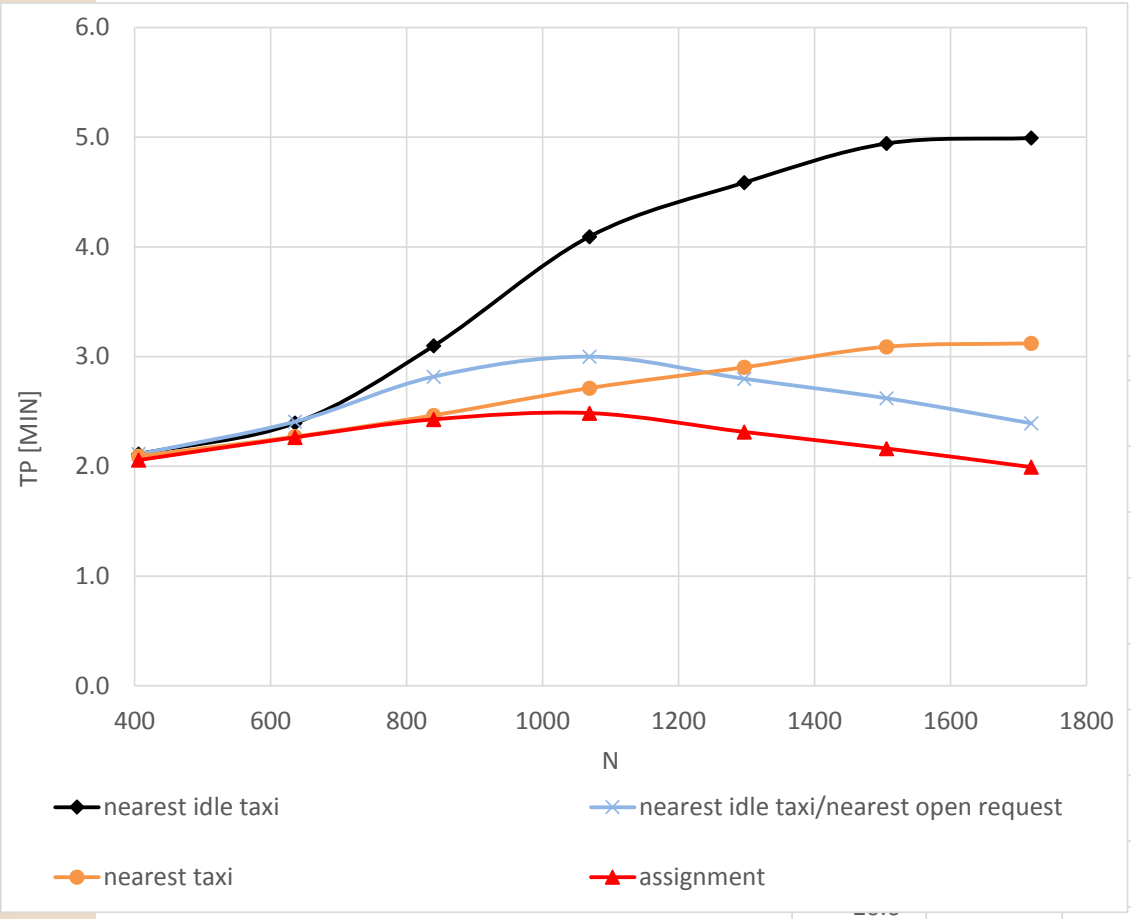
Dynamic assignment problem

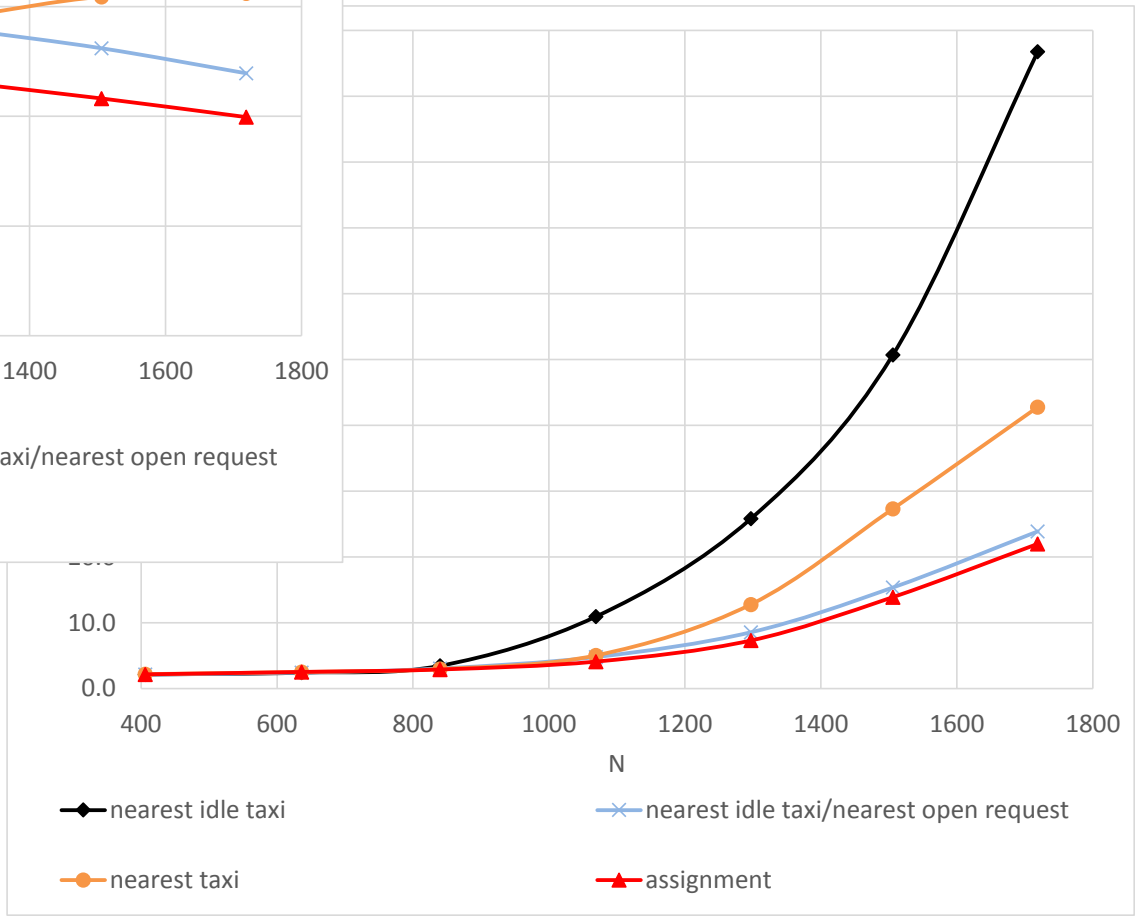


Dynamic assignment problem

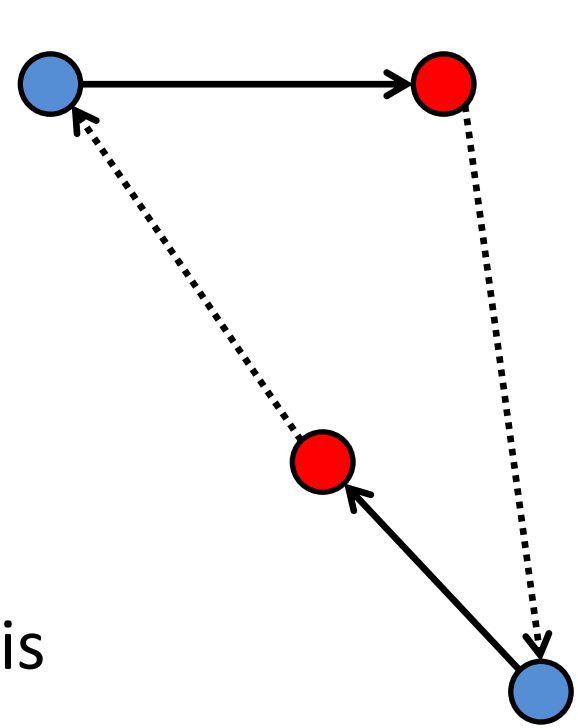


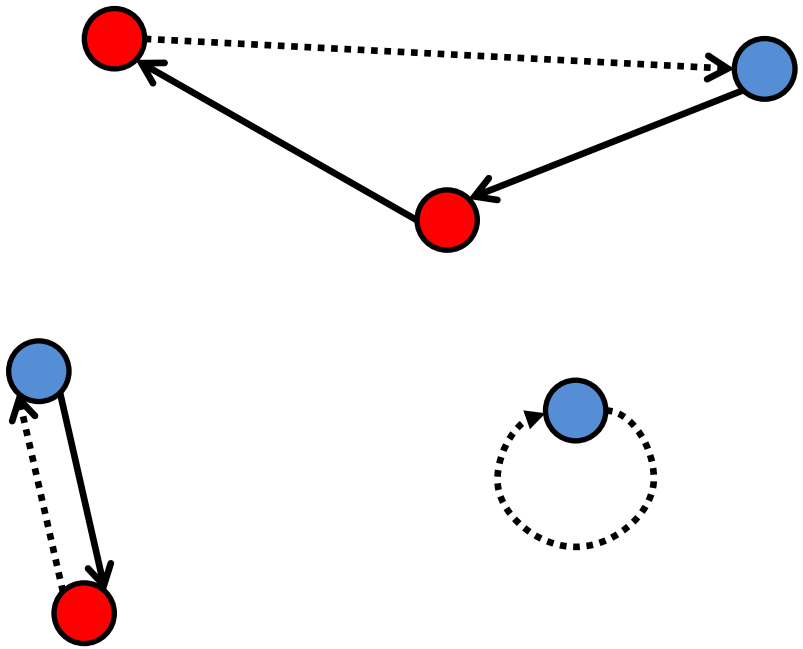
Dynamic assignment problem





Online exact optimization





Taxis

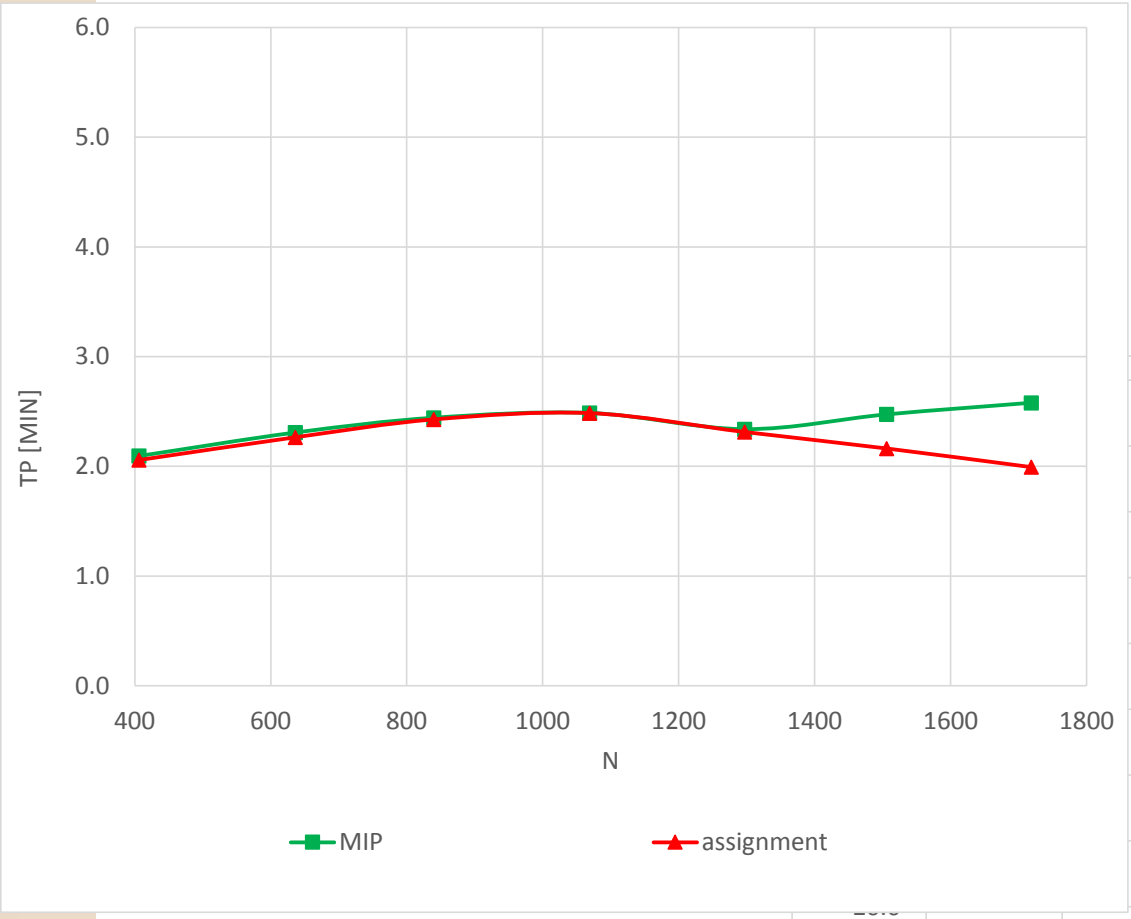
Requests

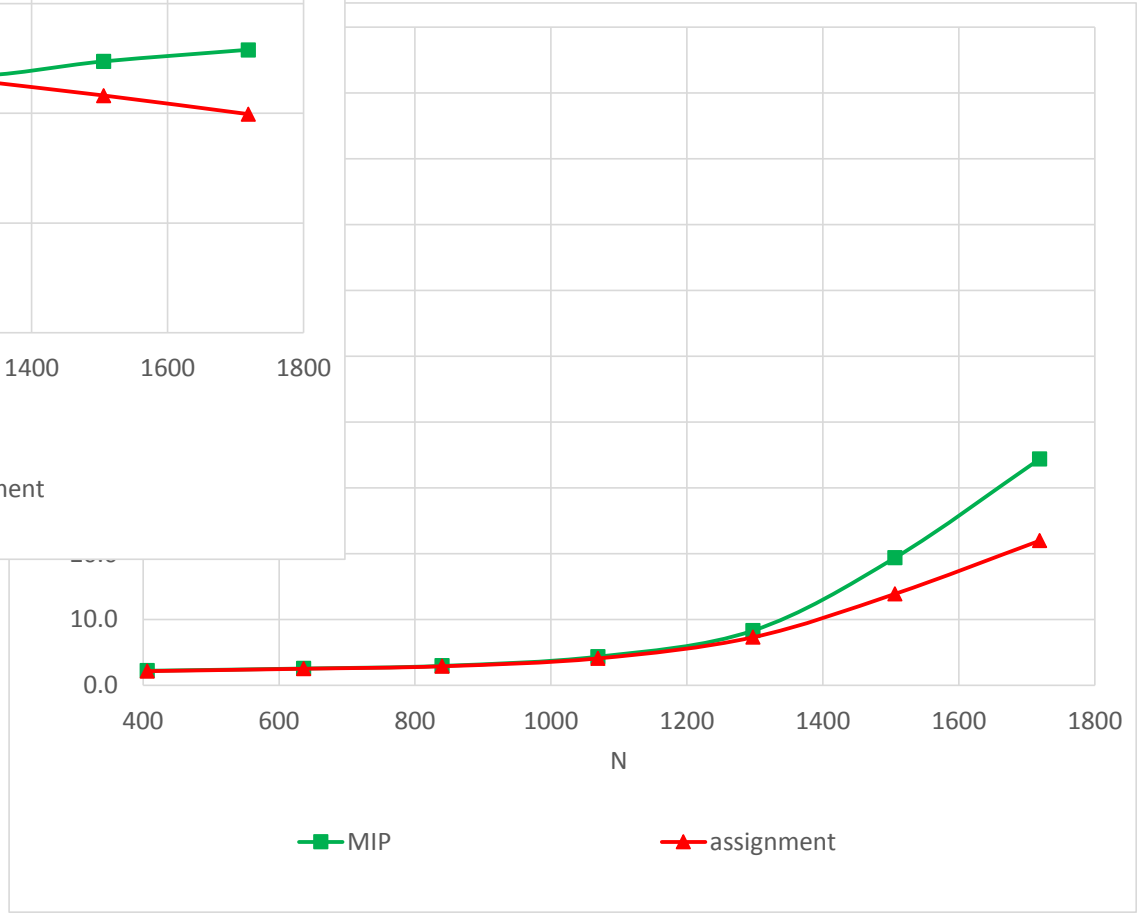
*Destinations known a priori

MIP

- taxi call – solve MIP
- pickup – solve MIP

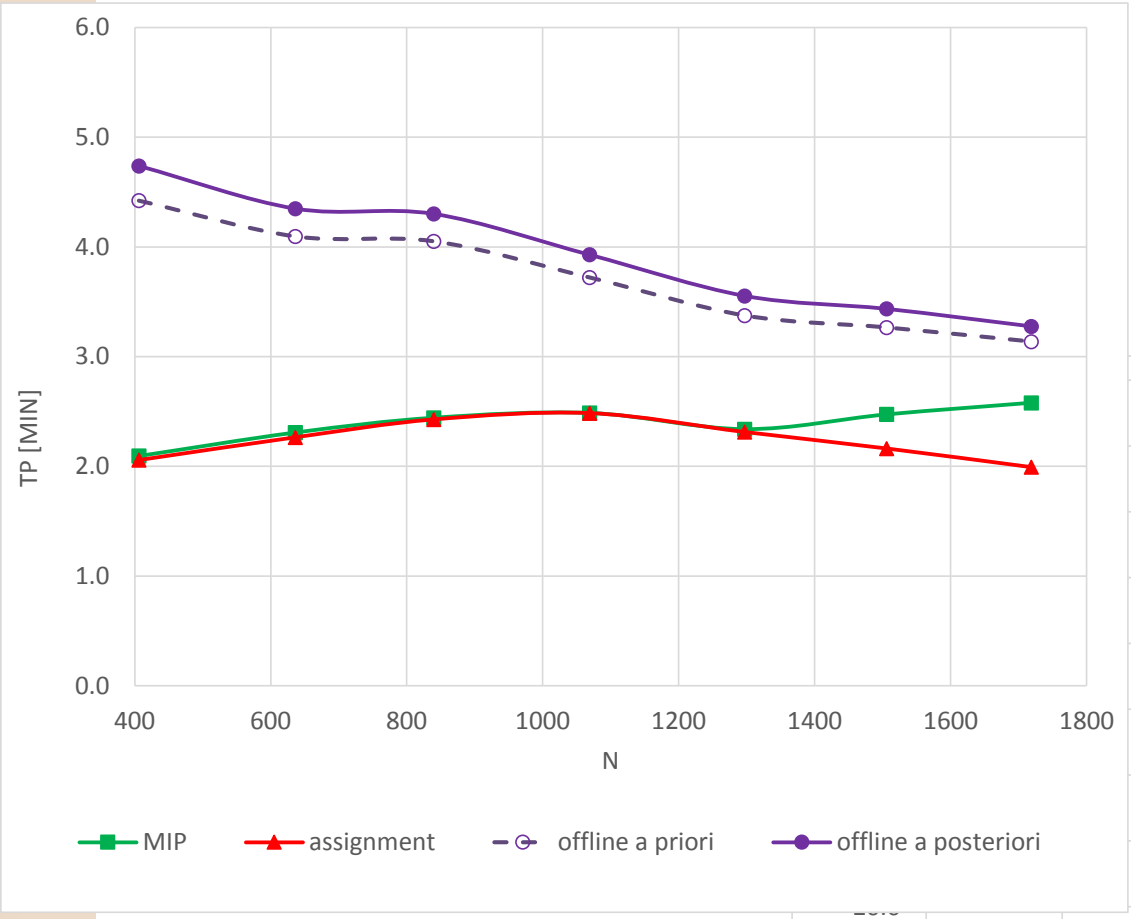
Online exact optimization

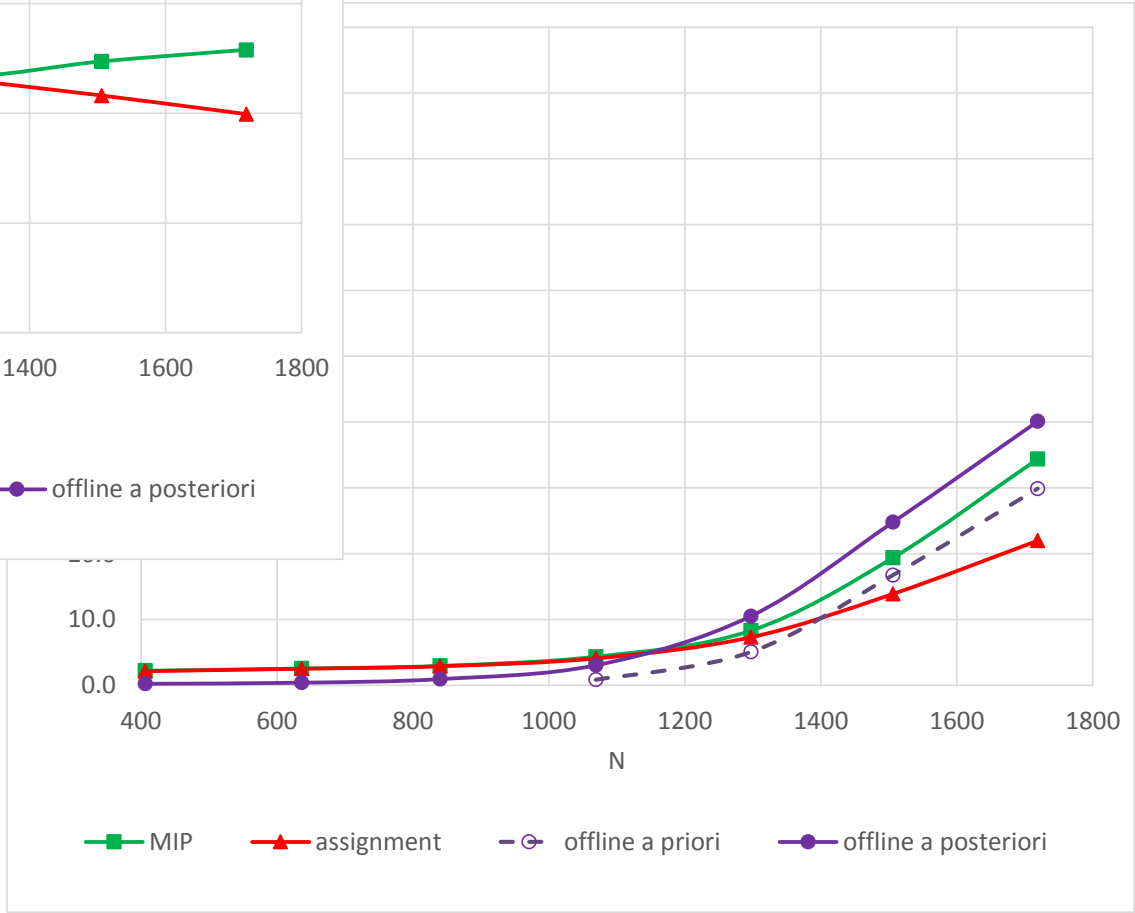




- $h = |M|$
- $T = 60$ s
- Gurobi, 6-core i7

Offline exact optimization





Conclusions

- Efficient (quality & time)
- Flexible (adaptation of cost function)
  - e-taxis
  - zone attractiveness
- Large-scale scenarios possible

THANKS

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