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Online Integration of mobiTopp and MATSim for Agent-Based Simulations of On-Demand Services (and beyond)

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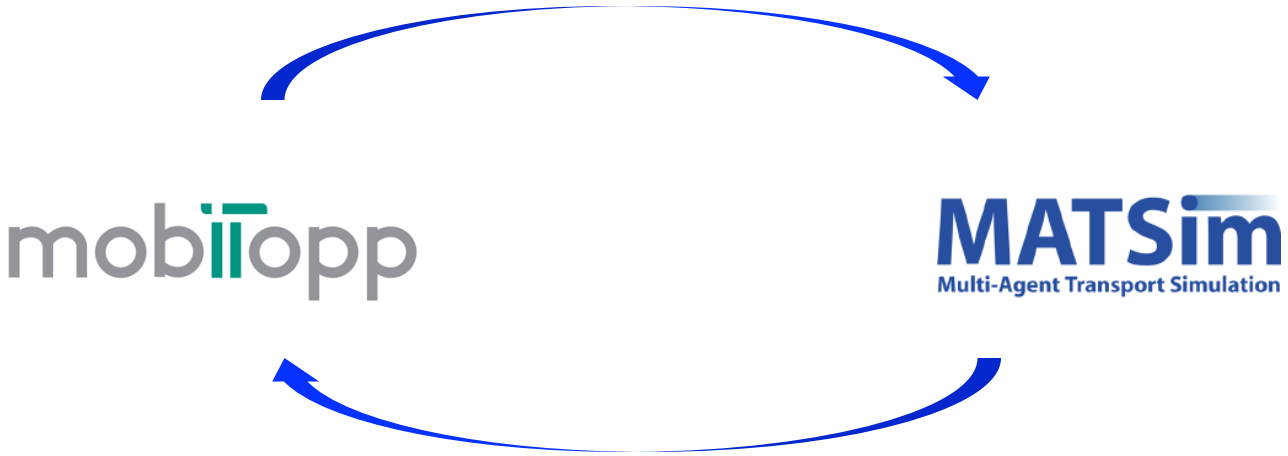
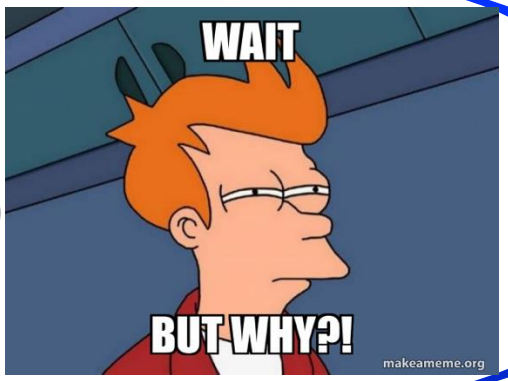
MOIA


mobiTopp
MATSim
Multi-Agent Transport Simulation

mobiTopp



MATSim
Multi-Agent Transport Simulation

The ALIKE project unites seven partners in their expertise in **bringing autonomous ridepooling to Hamburg's streets**

MOIA

Operator	Software/App	Vehicles	Accompanying research	Project support
HOCHBAHN MOIA OPERATIONS	MOIA	HOLON Nutzfahrzeuge	KIT Karlsruher Institut für Technologie	Hamburg | Behörde für Verkehr und Mobilitätswende

Autonomous driving functions

Digital booking

Technical supervision

Acceptance

Structure of the overall system

Accessibility

ALIKE introduces 2 AD-Vehicles in a testbed to Hamburg streets

VW ID.Buzz AD

- Up to 10 prototype vehicles
- Up to 4 passengers, SDS von Mobileye

HOLON Mover

- Up to 10 prototype vehicles
- Up to 15 passengers, SDS von Mobileye

MOIA

On-demand transport may be a bit more complex than other modes

I will take my bike!

I *would like* to take DRT!

Approved trip

No or 'bad' offer

Fallback alternative or drop trip

MOIA

On-demand transport may be a bit more complex than other modes

I will take my bike!

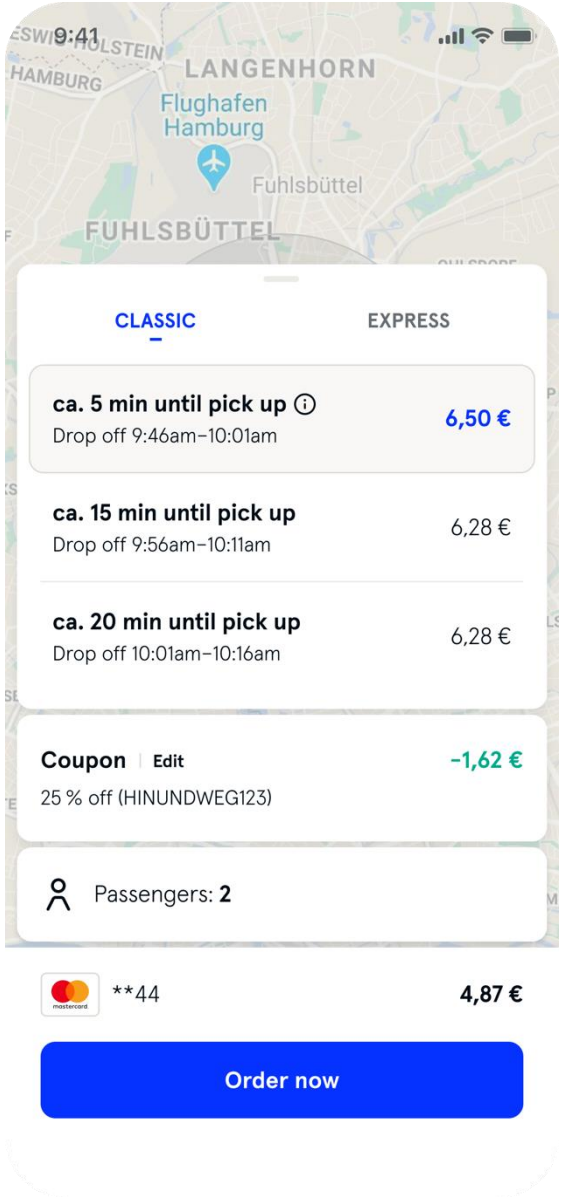
Decision usually taken between iterations in MATSim!

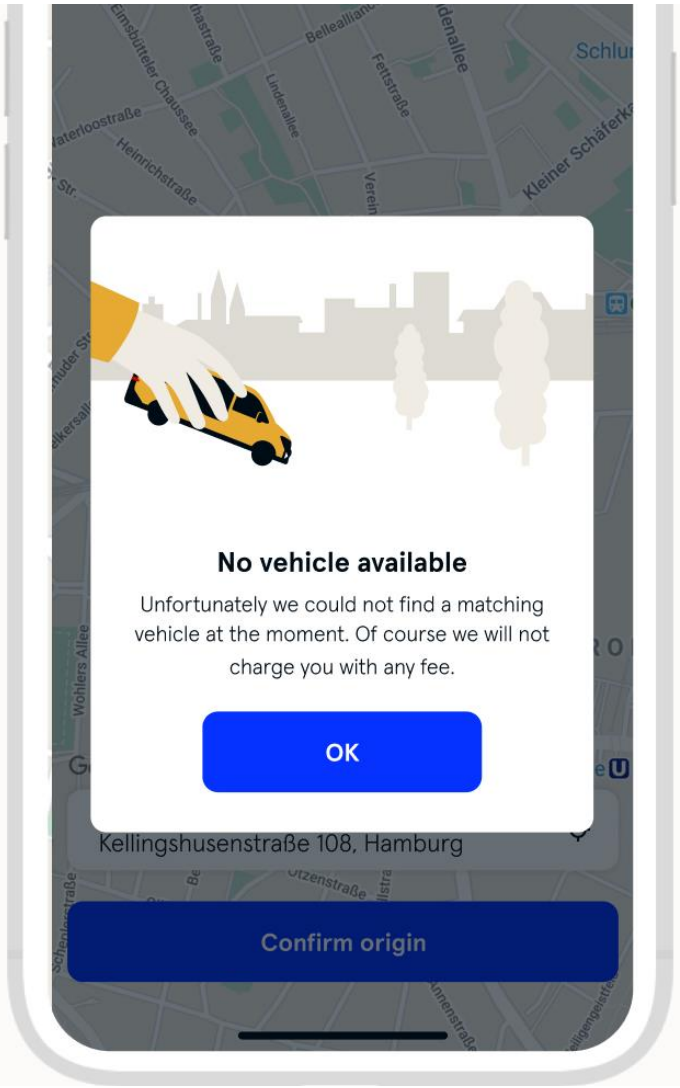
I *would like* to take DRT!

Approved trip

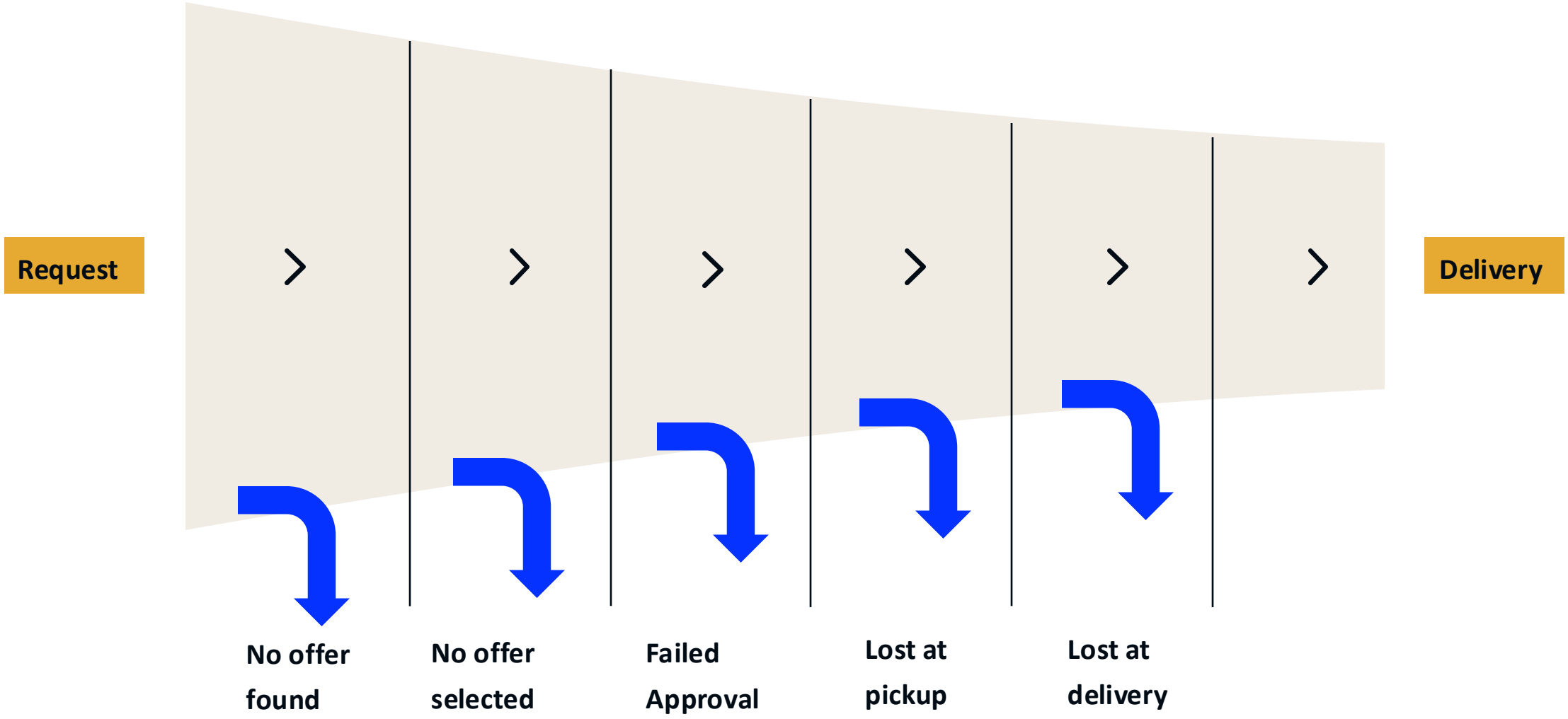
No or 'bad' offer

Fallback alternative or drop trip

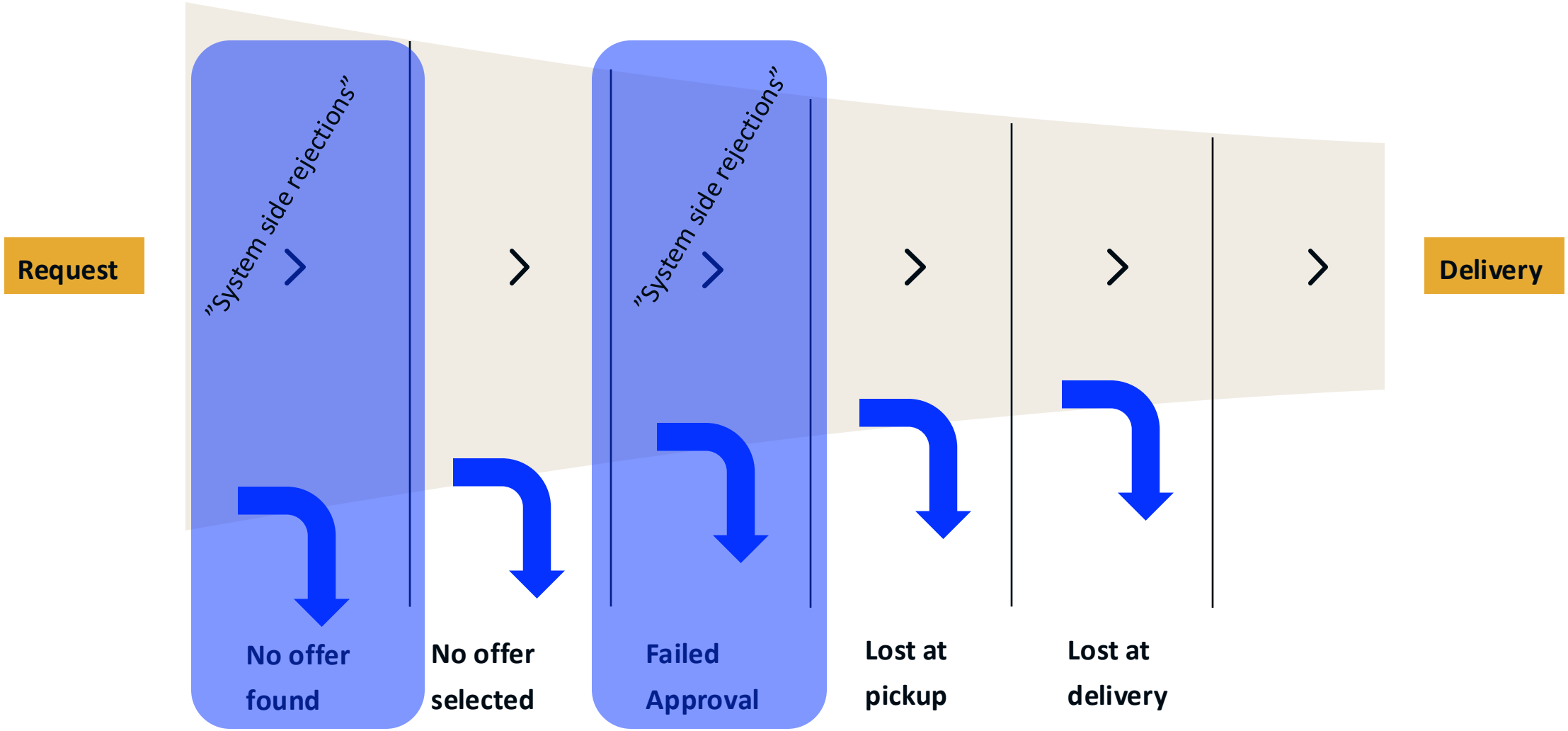

9:41
HAMBURG
LANGENHORN
Flughafen Hamburg
Fuhlsbüttel
FUHLSBÜTTEL
CLASSIC
EXPRESS
ca. 5 min until pick up
Drop off 9:46am–10:01am
6,50 €
ca. 15 min until pick up
Drop off 9:56am–10:11am
6,28 €
ca. 20 min until pick up
Drop off 10:01am–10:16am
6,28 €
Coupon
Edit
-1,62 €
25 % off (HINUNDWEG123)
Passengers: 2
**44
4,87 €
Order now


No vehicle available
Unfortunately we could not find a matching vehicle at the moment. Of course we will not charge you with any fee.
OK
Kellingshusenstraße 108, Hamburg
Confirm origin

A ride request may fail at multiple steps



Default MATSim DRT only handles system side rejections



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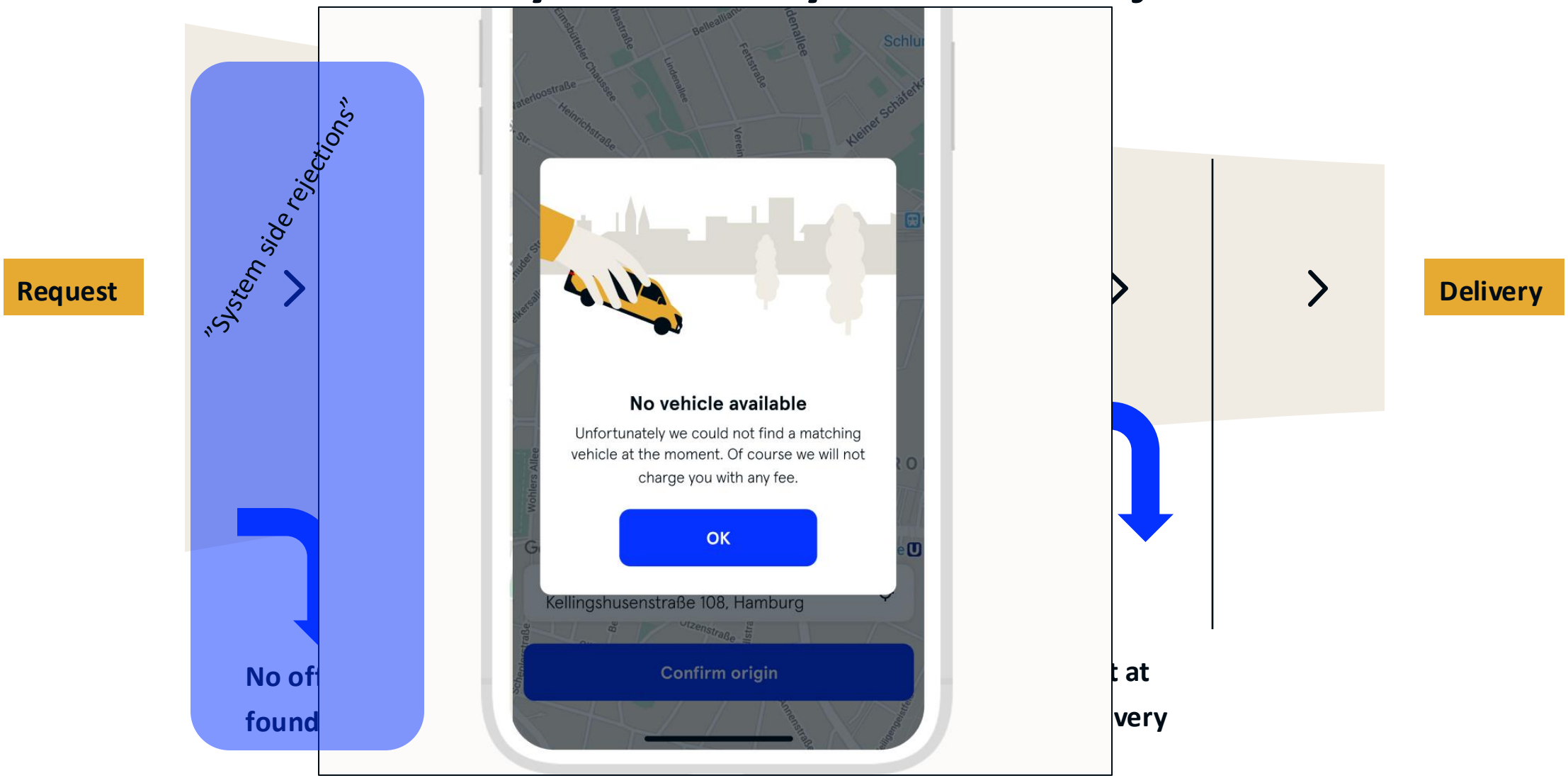
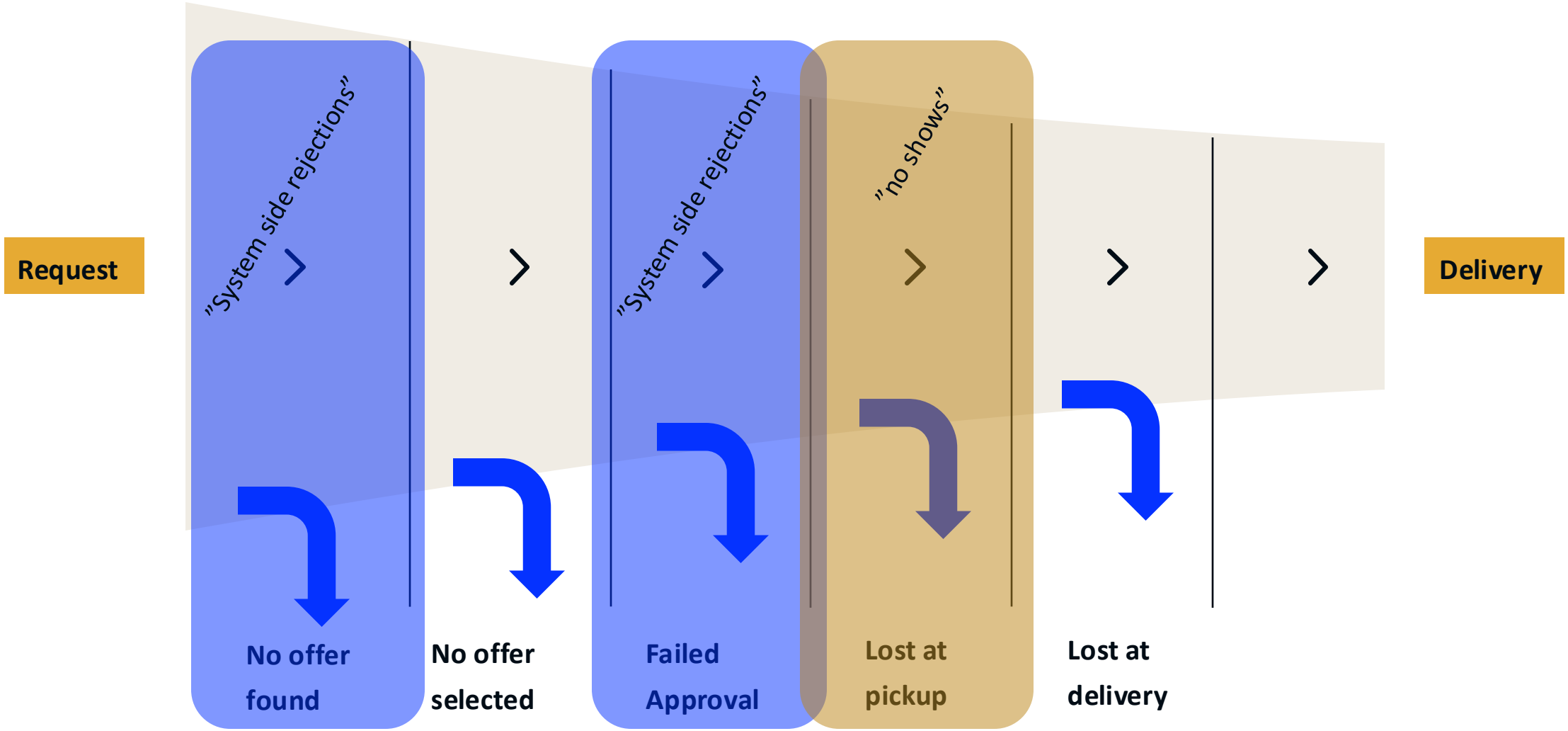
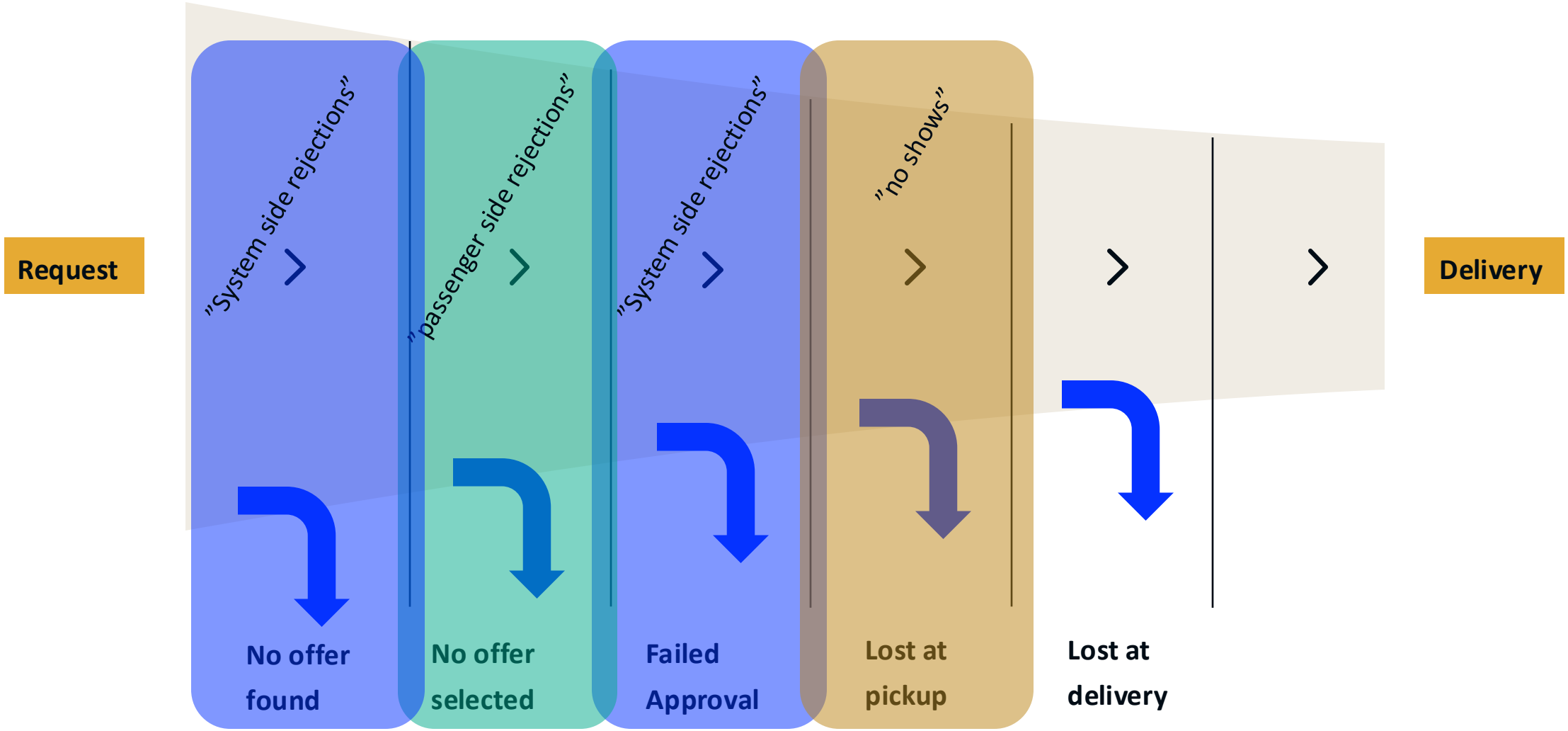


The prebooking extension can handle „no shows“



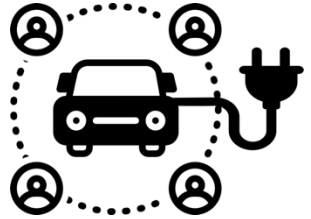
There is a need to model passenger side rejections



mobiTopp

- Agent- and activity-based travel demand modeling framework
- Open source, written in Java, currently re-engineered in Kotlin
- Split into:
  - “Long term” module (population synthesis etc.)
  - “short term” module (chronological simulation)
- Models with more than 3 million agents
- Feasible simulation runtimes with 100% population

Consistent behavior of people and households throughout one week



Individual private and shared vehicles with inter-dependencies

Ownership models for car, transit pass, mobility services, …

Integration of numerous influences on mobility behavior
(discrete choice models)

Changes in the choice activities’ locations due to e.g., increase of working from home

Combining several modes on one route (intermodal trips)

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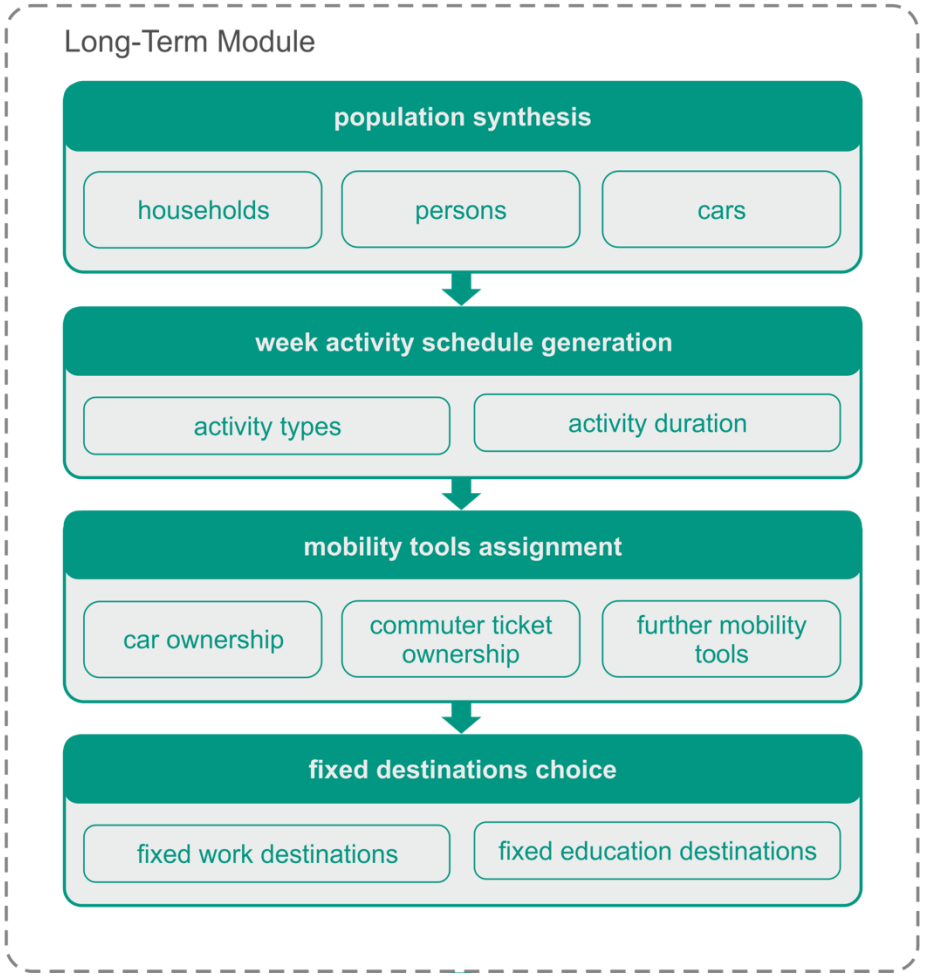

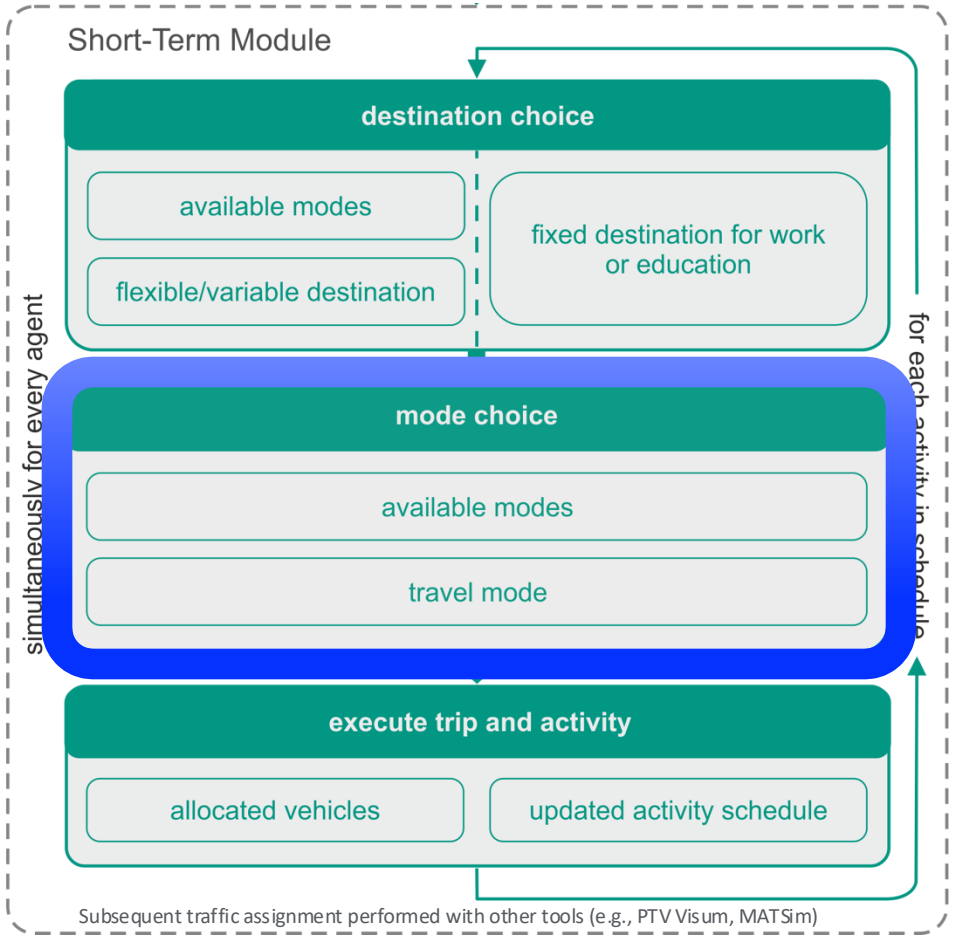

Illustrative communication

- Currently _every_ agent sends a request
- For the future, we aim for finding “interested candidates” that actually consider DRT
- Agents need to be able to choose a fallback mode (from a reduced choice set?)
- From real world MOIA data we can already estimate selection models based on shown offers

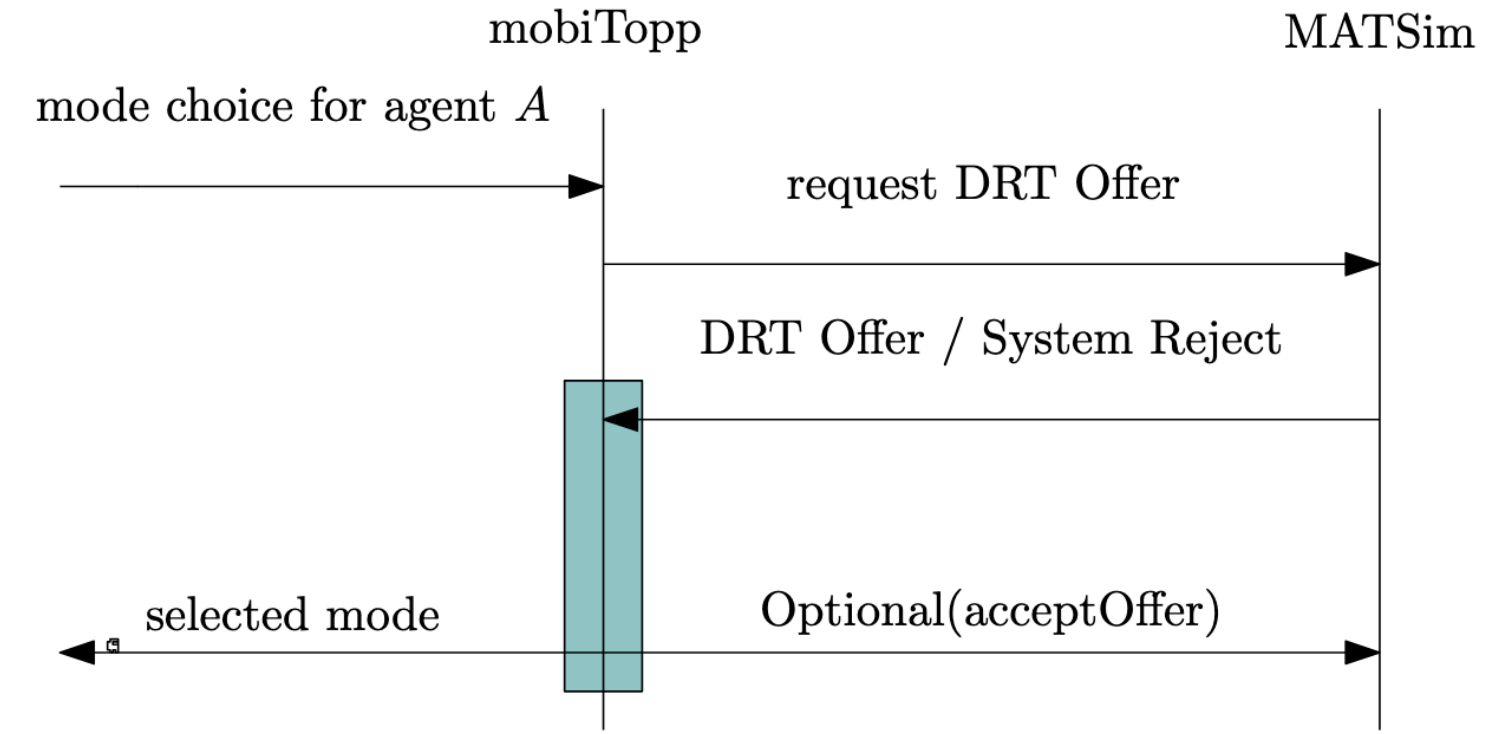

Figure 1: Example communication between mobiTopp and MATSim

Trip based coupling

- Technically, for each trip,

1. the agent is cloned as a MATSim agent
2. A plan is created with a single leg connecting origin and destination
3. MATSim’s trip router is executed on the clone
4. The agent is inserted into the mobsim immediately

- mobiTopp and MATSim are currently coupled at minute resolution

Test Scenario

- Small test scenario in Hamburg
- ~13k agents
- ~278k trips over one week
- bicycle, pt, car, car pass., walk, drt
- Two vehicles, five stops
- 87k rides without live coupling
- 16k rides with live coupling

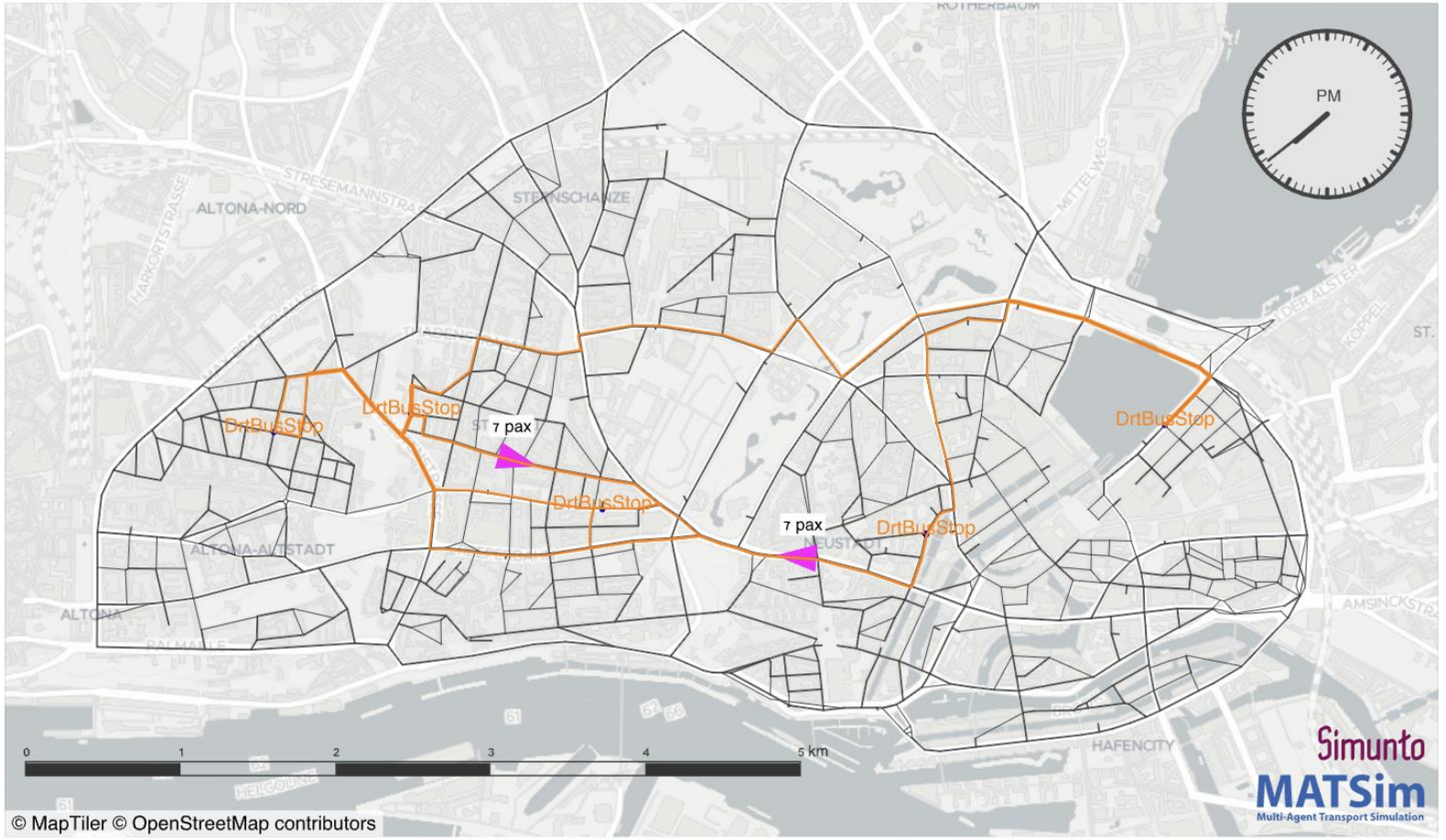

Figure 2: Visualization of the example scenario with five stop locations between which agents request rides.

Test Scenario

The setup allows us to distinguish between user and system rejections

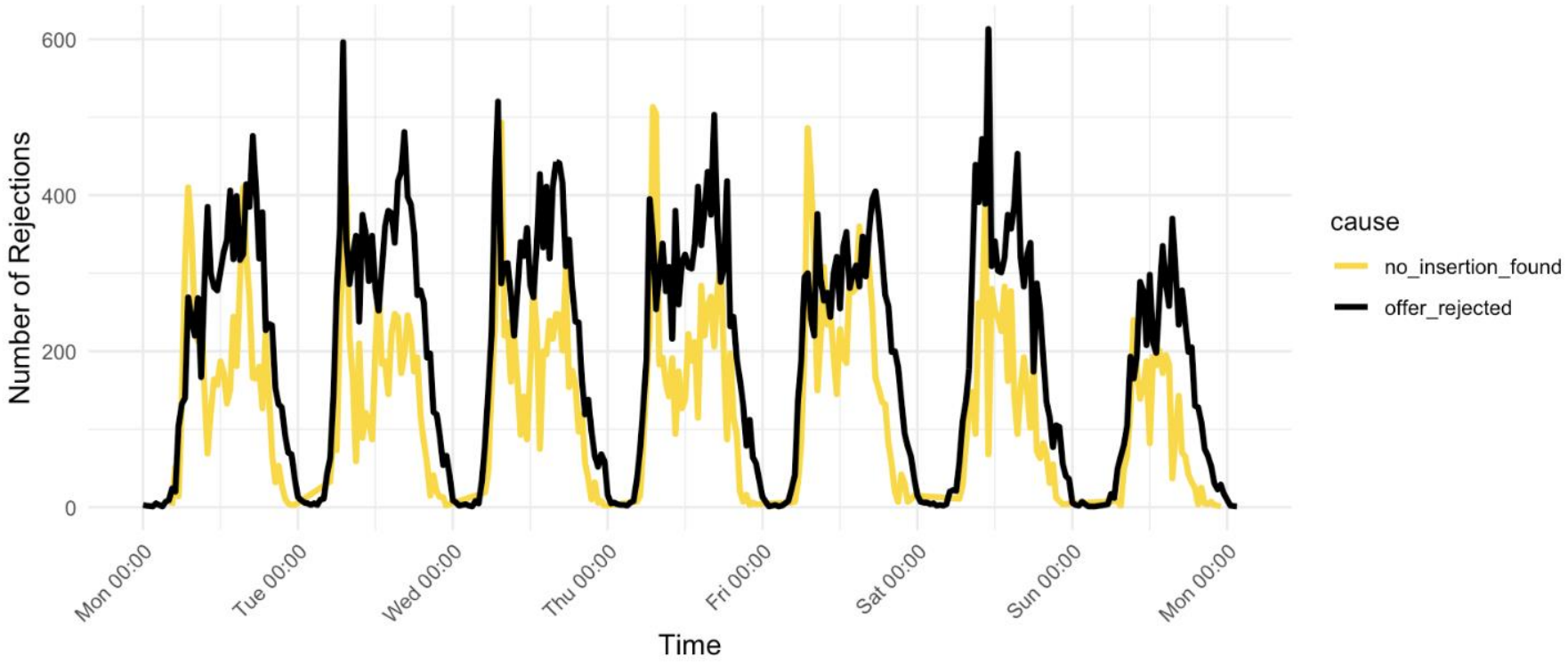

Figure 3: System-side and customer-side rejections over the course of the week.

Outlook

- Full behavioral model yet to be defined
- The same approach could be extended to virtually any mode
  - Live PT-Routing based on occupancy and delays
  - Live car-routing based on current congestion levels (may need pre-iterated traffic levels)
  - Etc…
- Performance is a bottleneck, the synchronization between mobiTopp and MATSim is currently under investigation
- Change from trip-based MATSim clones to fully sync’ed agents (propagate delays and and ensure time-space consistency)

Thank you

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MOIA

MOIA

https://github.com/moia-oss/matsim-aws