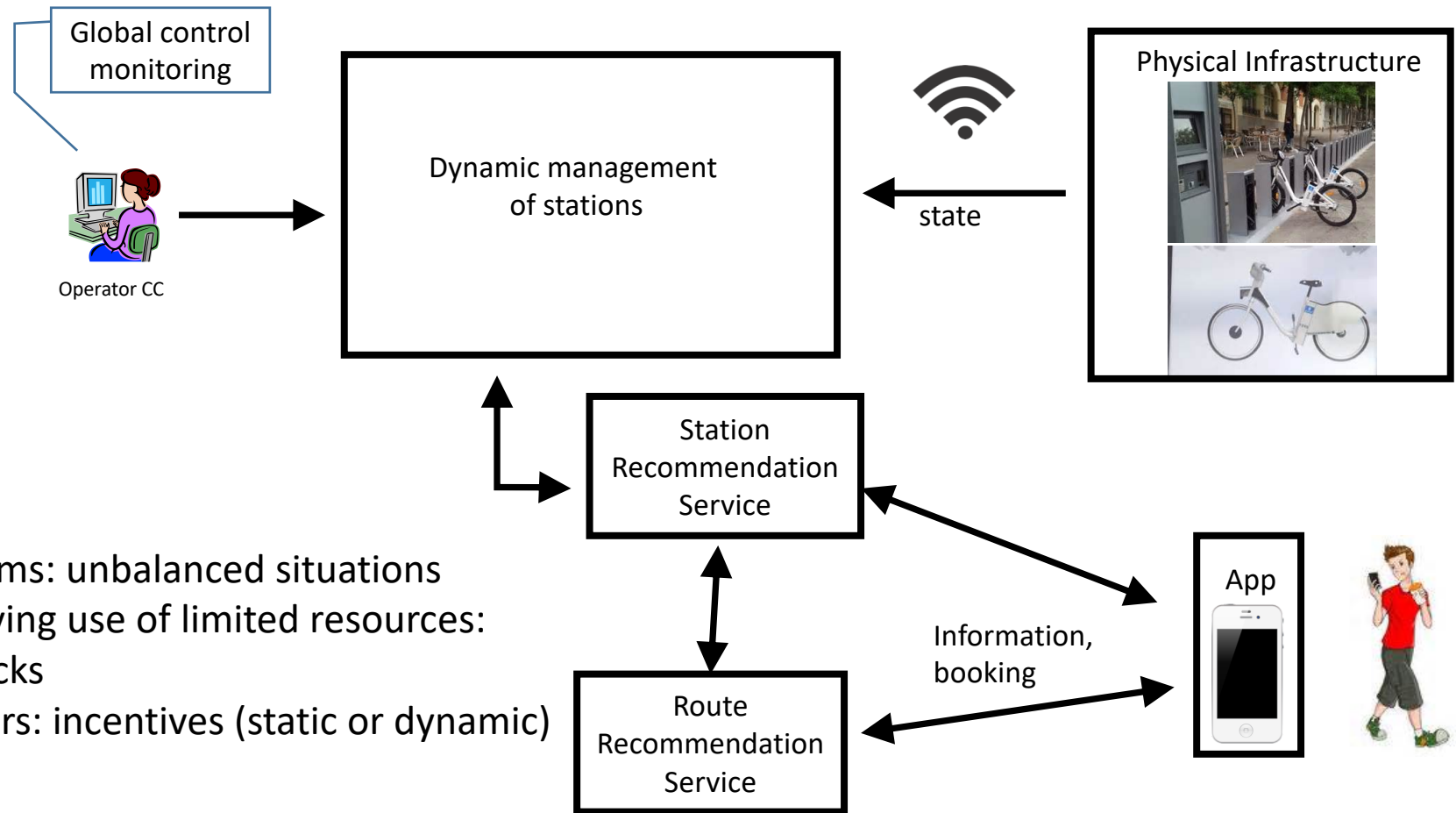

A Bike Sharing System Simulator

Alberto Fernández, Sandra Timón, Carlos Ruiz, Tao
Cumplido, Holger Billhardt, Jürgen Dunkel
SCIA at PAAMS 2018.
Toledo, 20-22 June, 2018

(Station-based) Bike-sharing systems

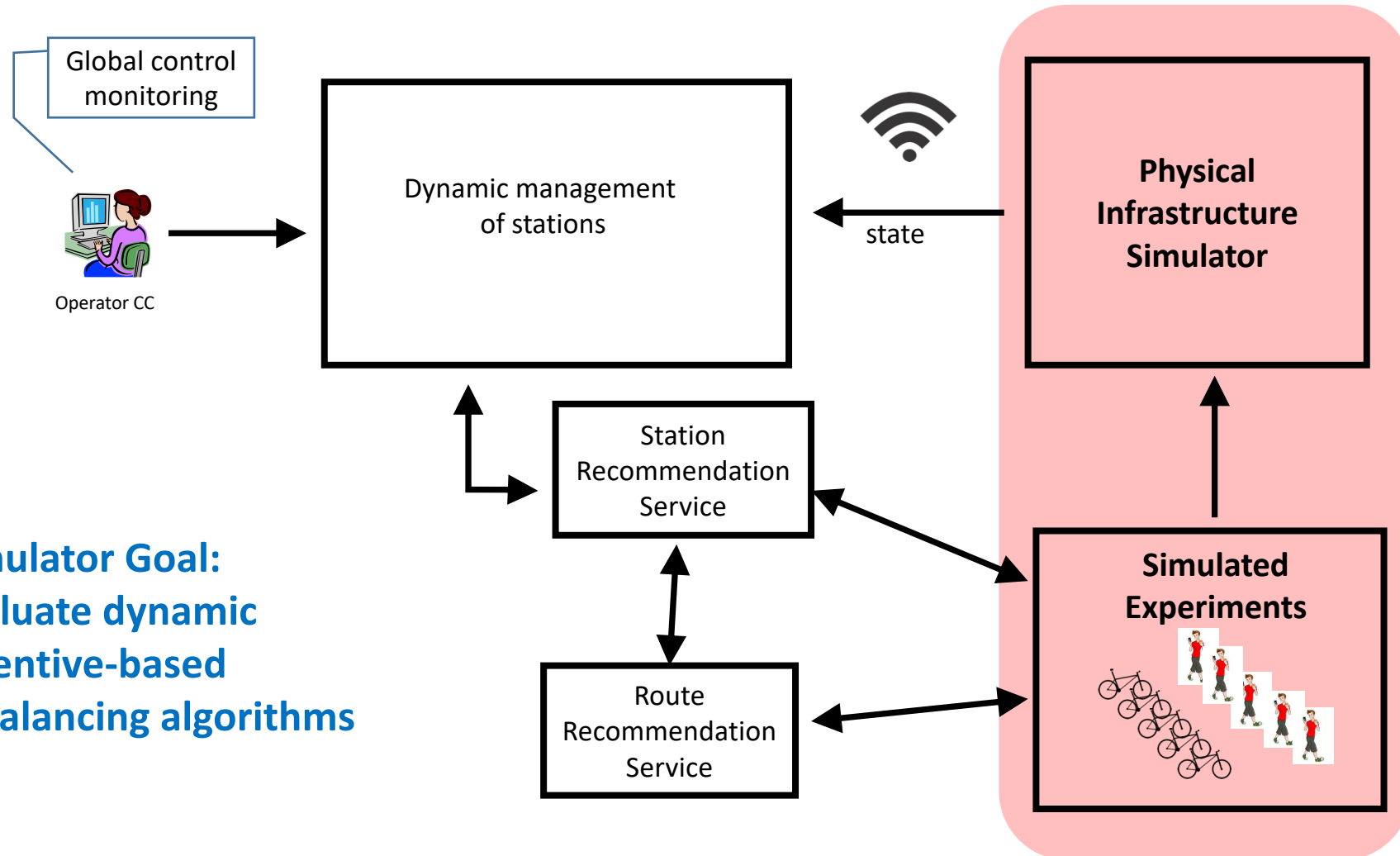


Problems: unbalanced situations

Improving use of limited resources:

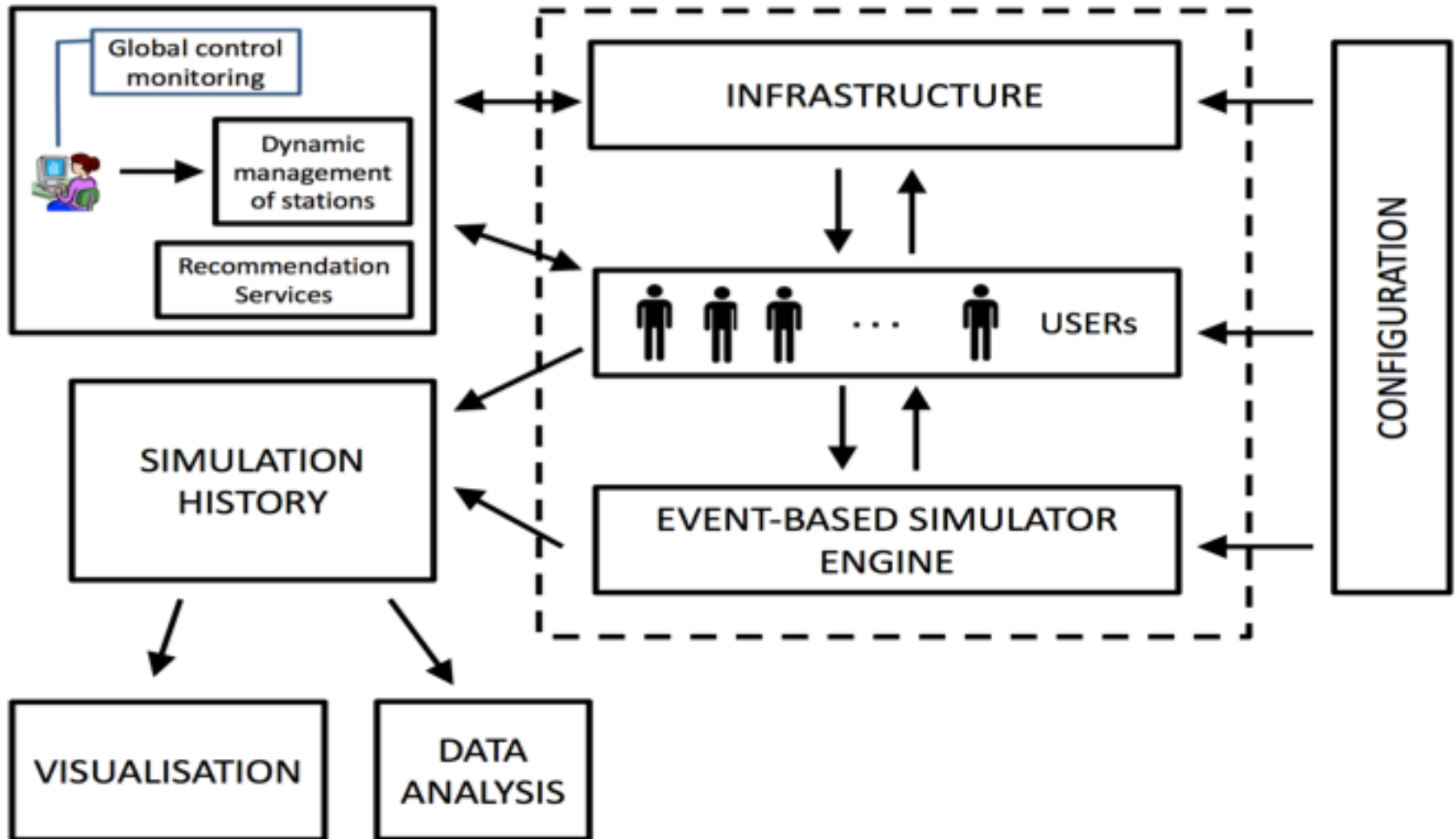
- Trucks
- Users: incentives (static or dynamic)

(Station-based) Bike-sharing systems



Simulator Goal:
Evaluate dynamic
incentive-based
rebalancing algorithms

Architecture

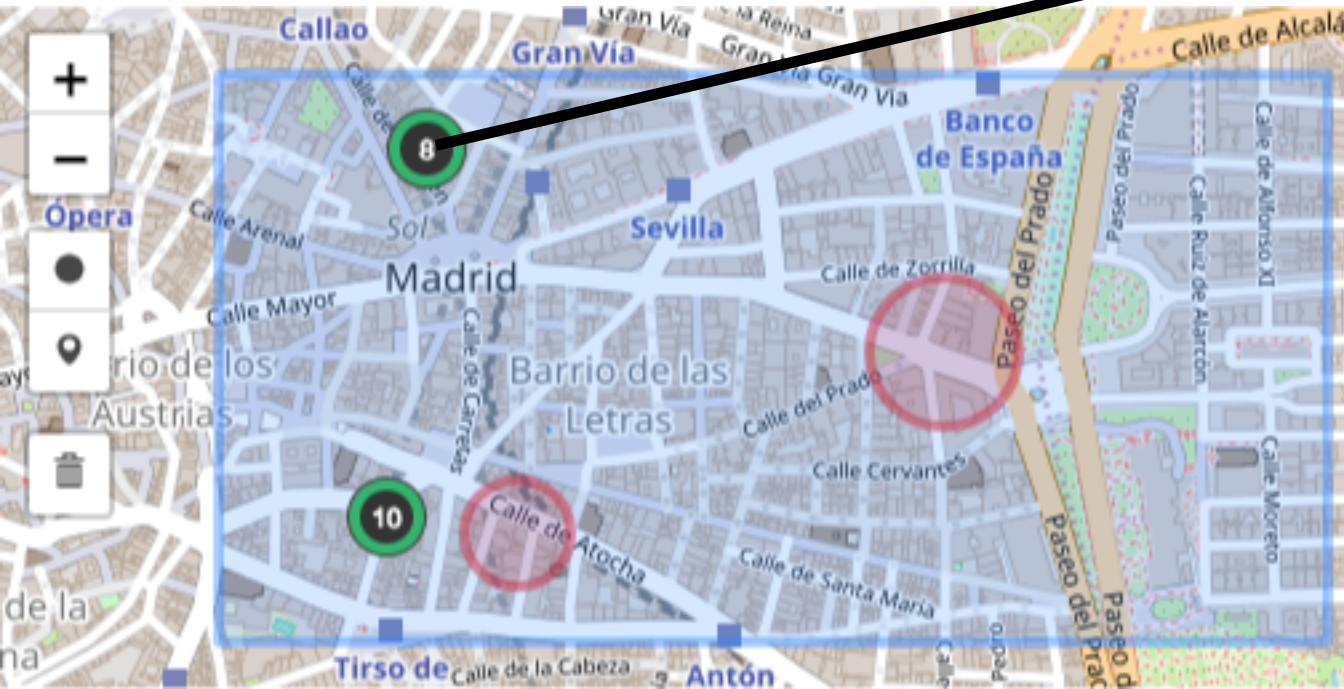


Users

- Appear at “entry points”
 - Probability distribution
- Behaviour:
 - Extensible set of user types:
 - Uninformed, Informed, Obedient, Informed-R, Obedien-R, Commuter, Tourist, Distance/Resources, Most available resources, ...
 - Configuration parameters

Experiment Configuration

Infrastructure (stations)



Create Station

Position

Latitude *

40,42753597684656

Longitude *

-3,704795837402344

Capacity *

20

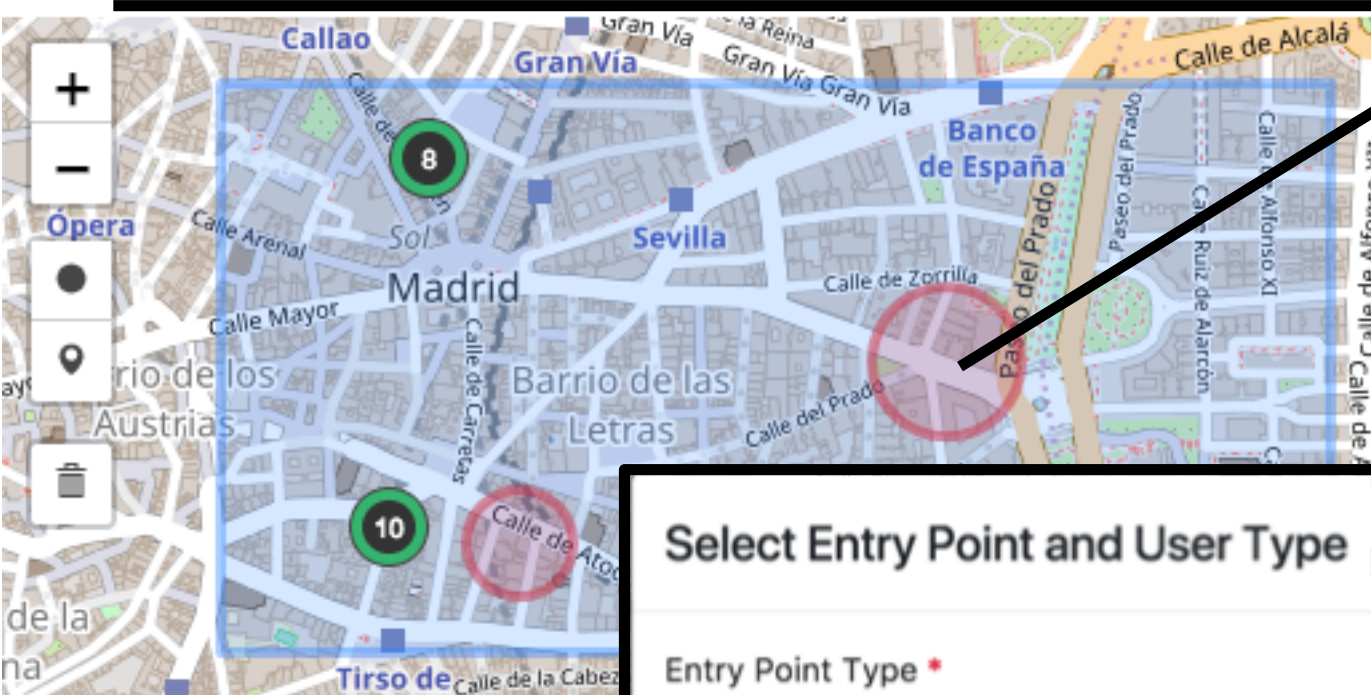
Bikes *

8

* = required fields

Submit

Experiment Configuration



User generation

Select Entry Point and User Type

Entry Point Type *

POISSON

User Type *

USER_OBEDIENT

* = required fields

Submit

Entry Point parameters

Distribution

Lambda *

10

Position

Latitude *

40,42244640529165

Longitude *

-3,7073707580566406

Time Range

Start *

1000

End *

2000

Radius

111,93358003434021

Total Users

User Type

Parameters

Will Reserve

Experiment Configuration

Global configuration



General Configuration [Entry Points](#)

Stations

Total Simulation Time *

3600

Debug Mode

Reservation Time *

600

Random Seed

Bounding Box

North West

Latitude *

40,42807935816139

Longitude *

-3,7153571509601444

South East

Latitude *

40,41384156305805

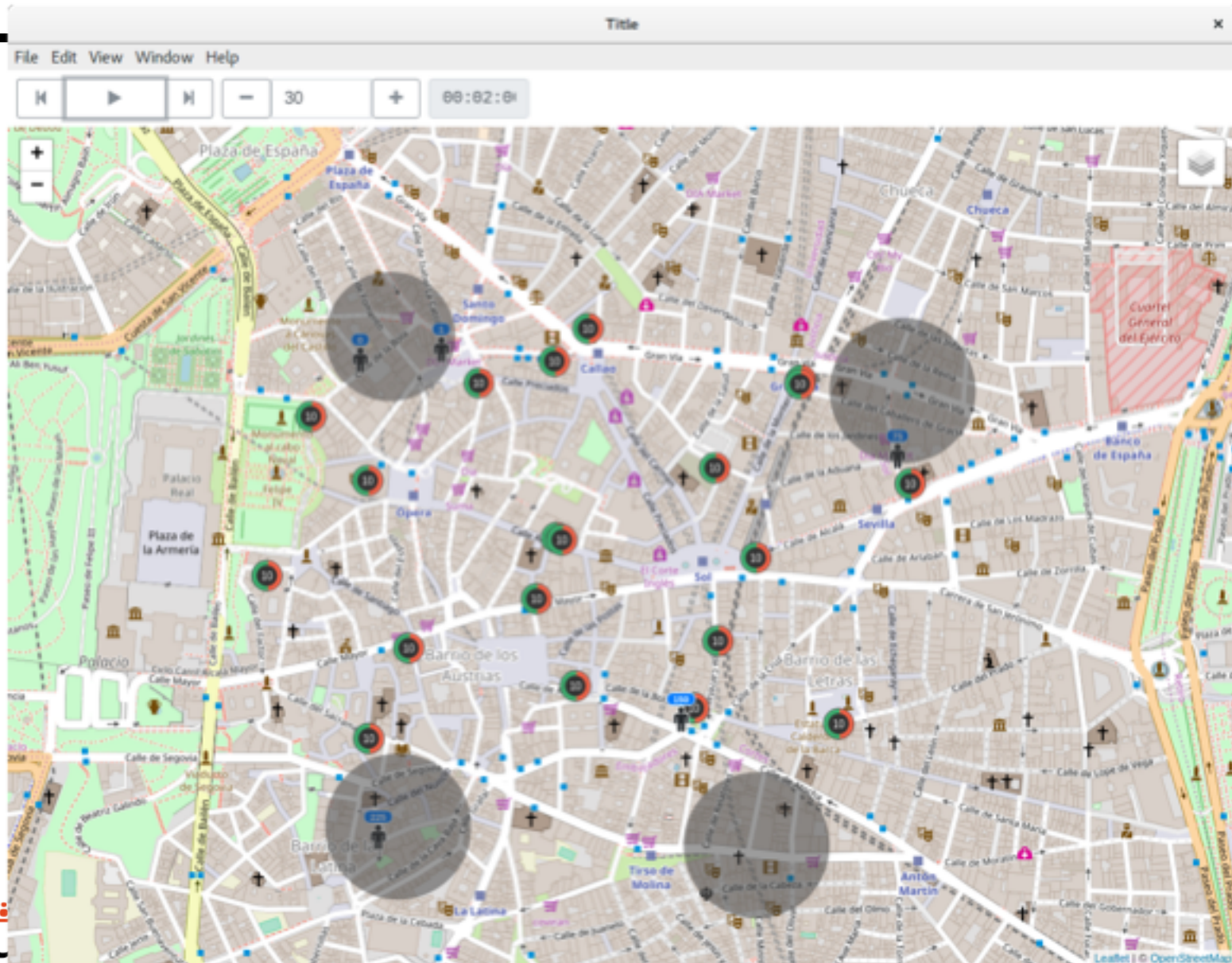
Longitude *

-3,6937368088135556

Map *

../map/madrid.osm

Visualisation



Visualisation



Data analysis

- *Demand satisfaction (DS)*

$$DS = SH / N$$

- *Return satisfaction(RS)*

$$RS = SR / SH$$

- *Hire efficiency (HE)*

$$HE = SH / (SH+FH)$$

- *Return efficiency(RE)*

$$RE = SR / (SH+FR)$$

- Empty time per station

N: # of users

SH: # of Successful Hires

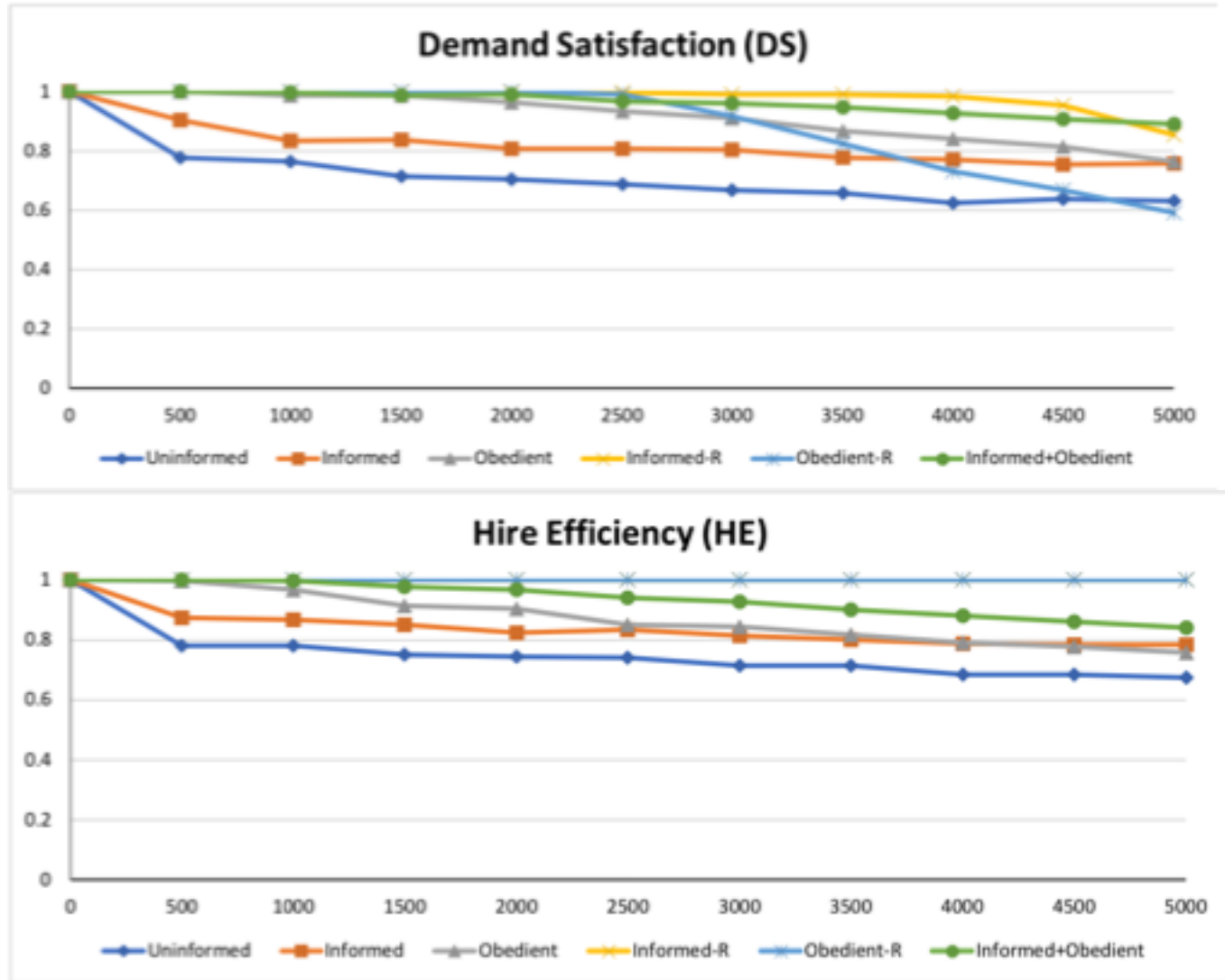
FH: # of Failed Hires

SR: # of Successful Returns

Evaluation

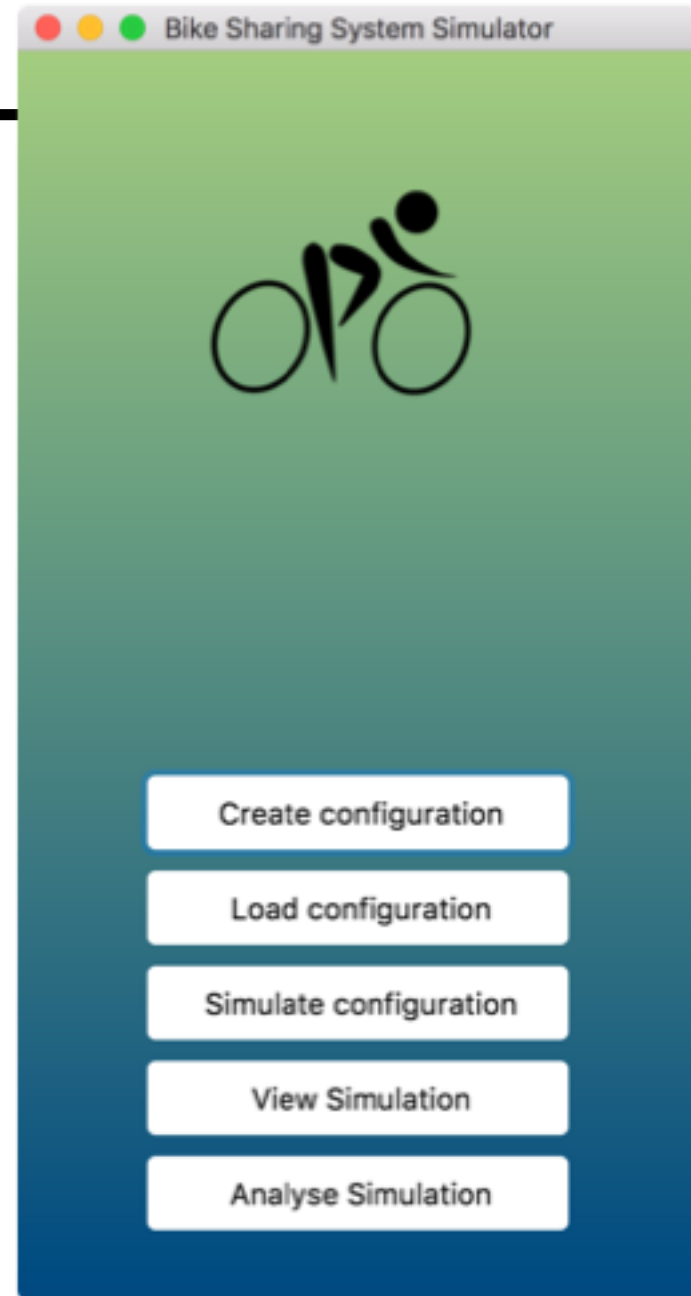
3 km²
20 stations
20 slots
10 bikes

Recommendation:
bikes / # slots



Conclusions

- Station-based simulator:
 - Available at:
<https://github.com/stimonm/Bike3S>
- Decoupled modules:
 - User generation, Simulation, Visualisation, Analysis
- Future lines
 - Improving simulator
 - Extendable Recommendation systems
 - GUI for Users and Recommendation configuration
 - Incentive-based balancing strategies
 - User models



Thanks!