RESILIENCE QUANTIFICATION FOR CRITICAL INFRASTRUCTURE: EXEMPLIFIED FOR AIRPORT OPERATIONS

ESORICS 2021 CPS4CIP workshop

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SATIE
Security of Air Transport Infrastructure of Europe

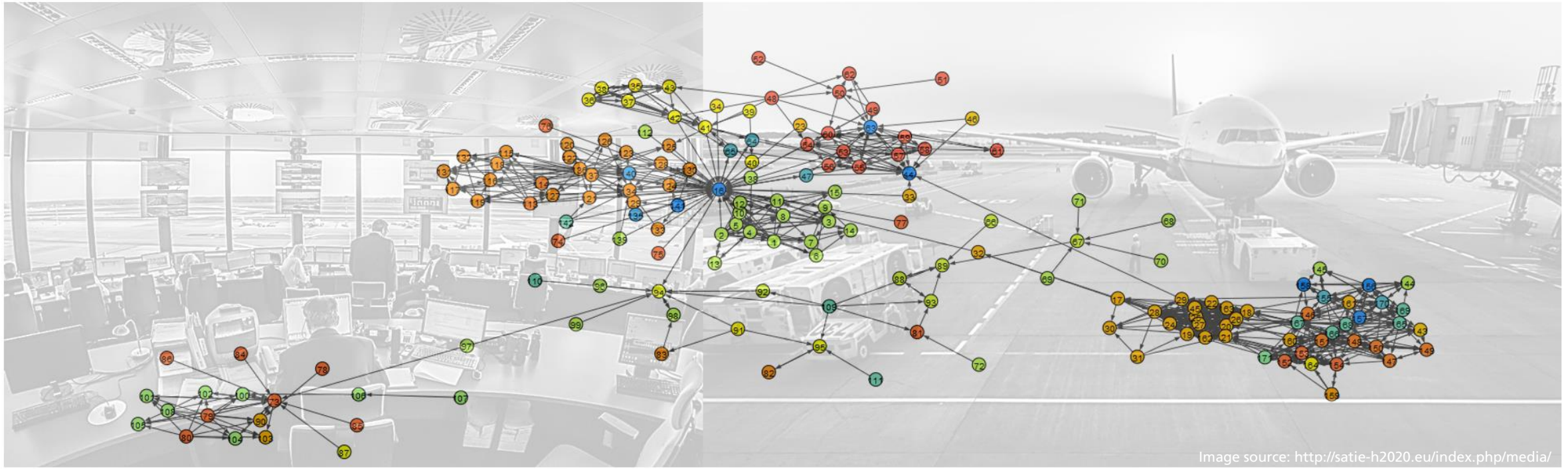
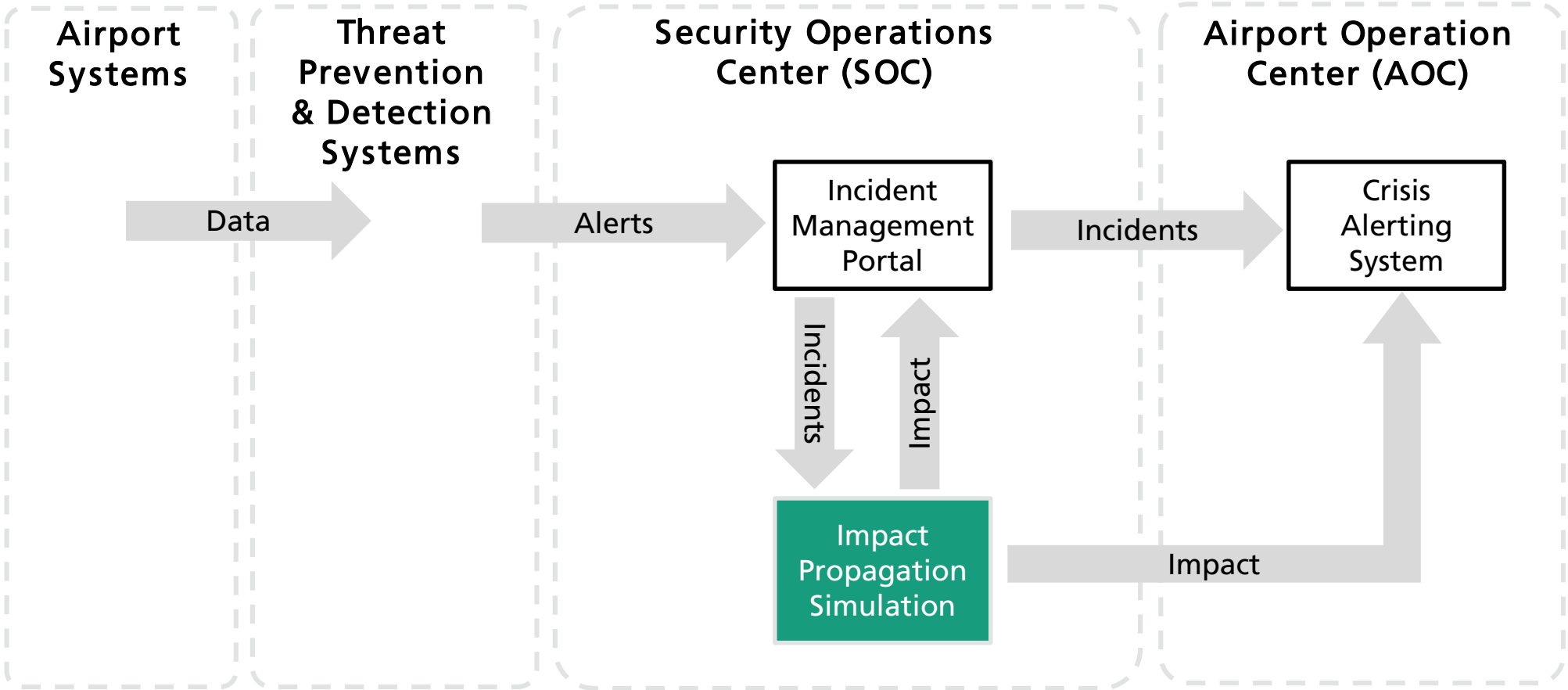


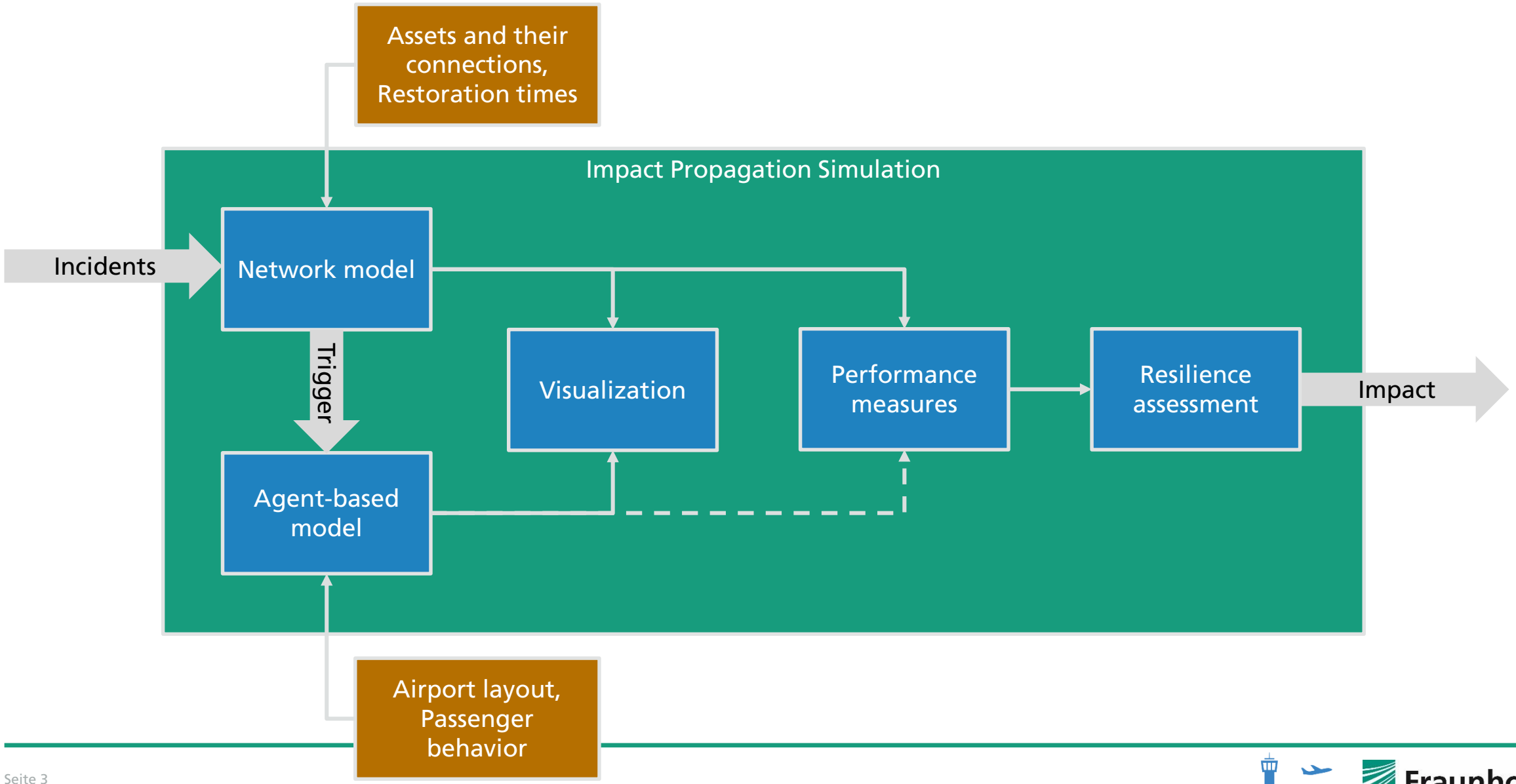
Image source: http://satie-h2020.eu/index.php/media/

Fraunhofer EMI

Section of the SATIE toolkit



IPS architecture

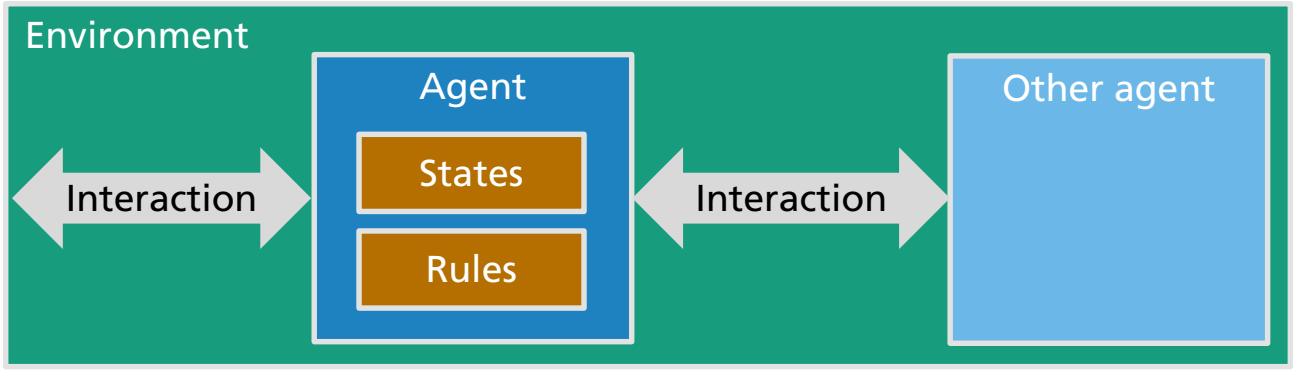


The scenario

- Malpensa Airport in Milan
- Gate and aircraft stand assignment manipulation due to Cyber-attack
- Non-Schengen gates (long distance travel)
- Schengen flights (short distance, business trip) got assigned to the non-Schengen gates
- Consequence: Accumulation of passengers

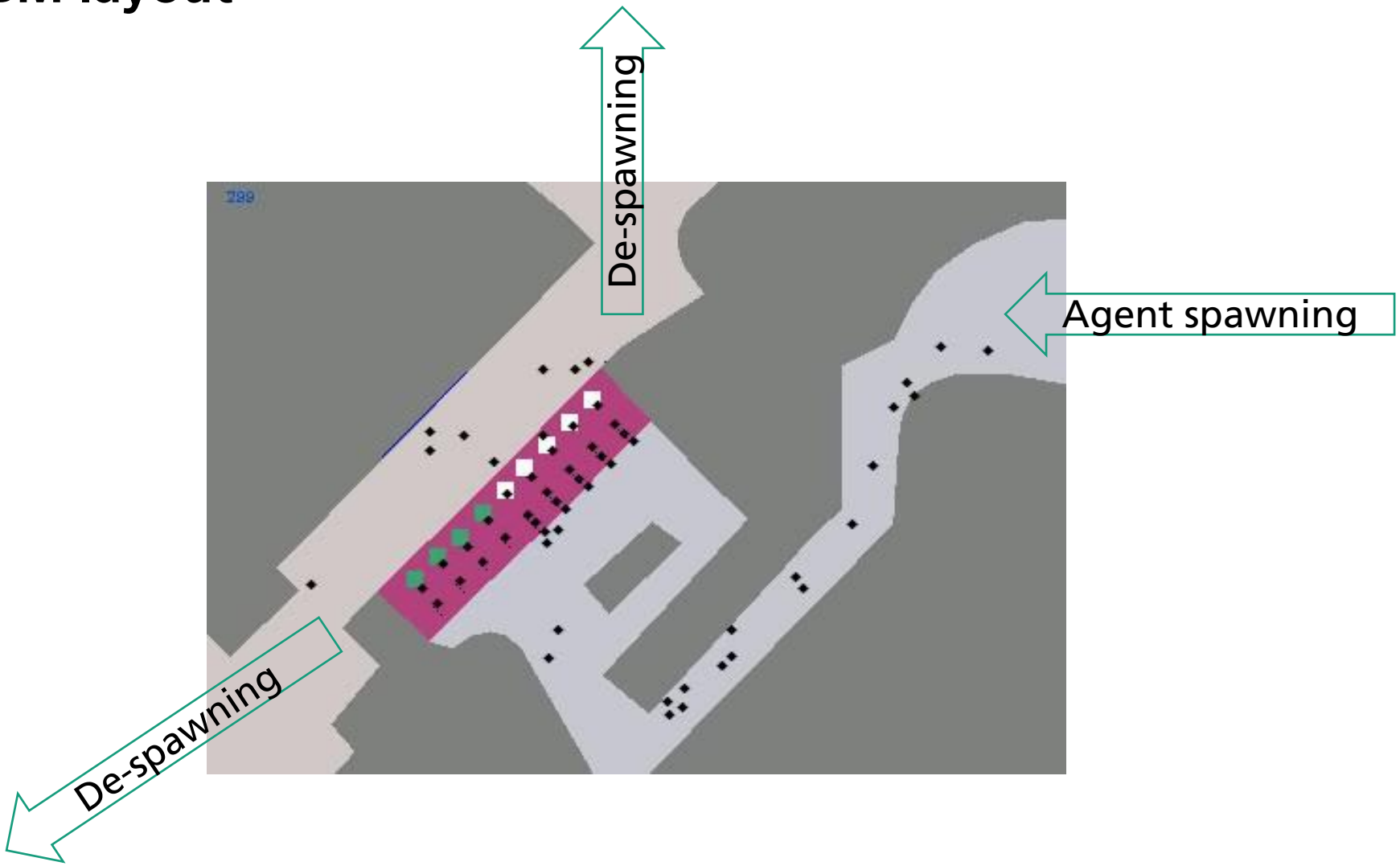

https://www.malpensaairporttravel.com/

Agent-based model (ABM)



Agent parameter	Value
Non-Schengen agent velocity mean	1.5 m/s
Schengen agent velocity mean	2.5 m/s
Agent velocity standard deviation	0.5 m/s
Agent size	0.8 m
Distance between agents	Agent size + 0.8 m
Distance to obstacles	Agent size/2 + 0.5 m
Simulation time steps	2000
Time step length	1 s
Spawn rate	1 agent every 4 time steps
Initial number of agents	25

ABM layout



Non-Schengen

Passport control

Manual check

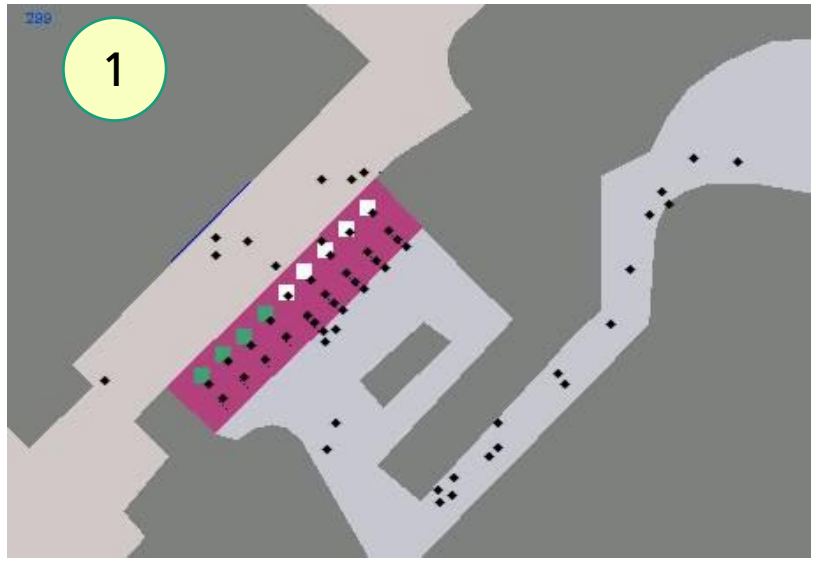
E-gate

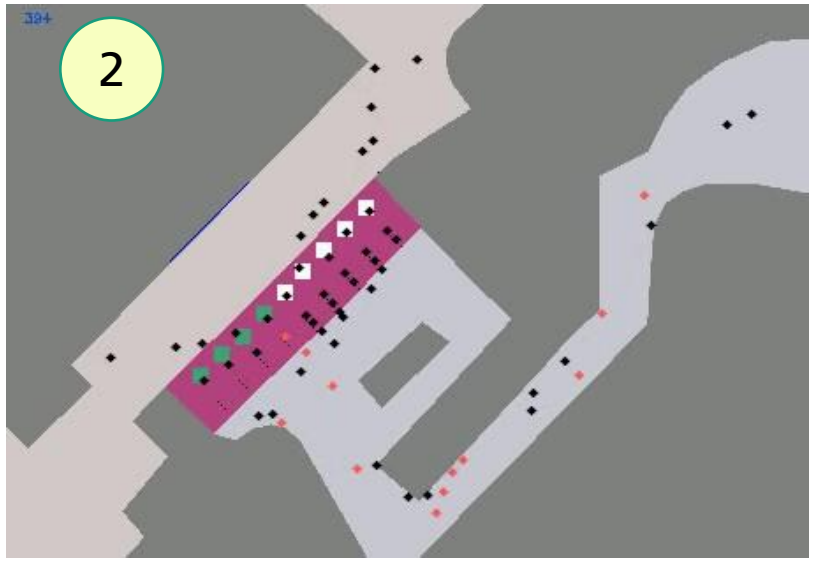
Landside

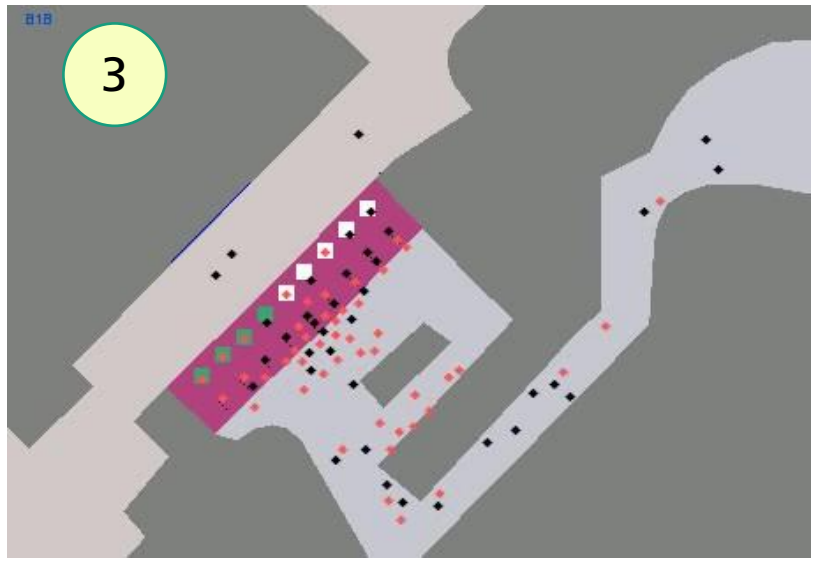
Airside

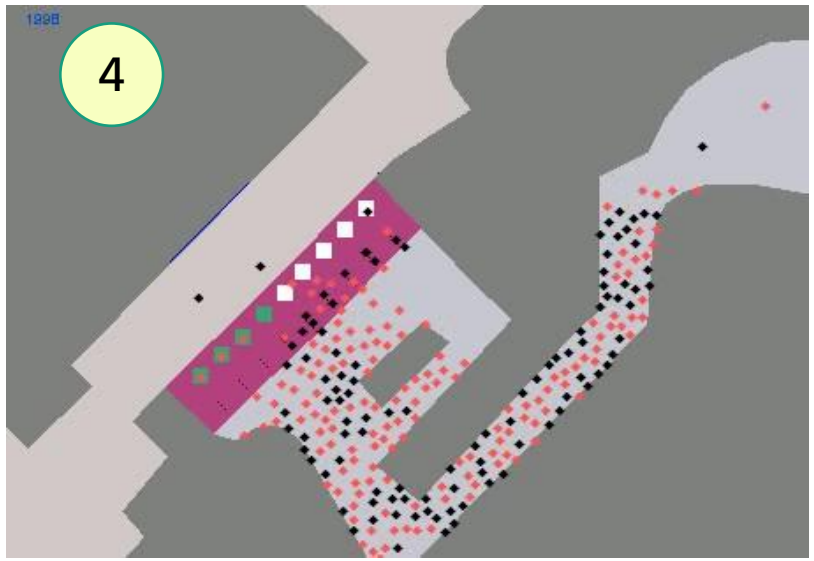
Fraunhofer EMI

ABM simulation









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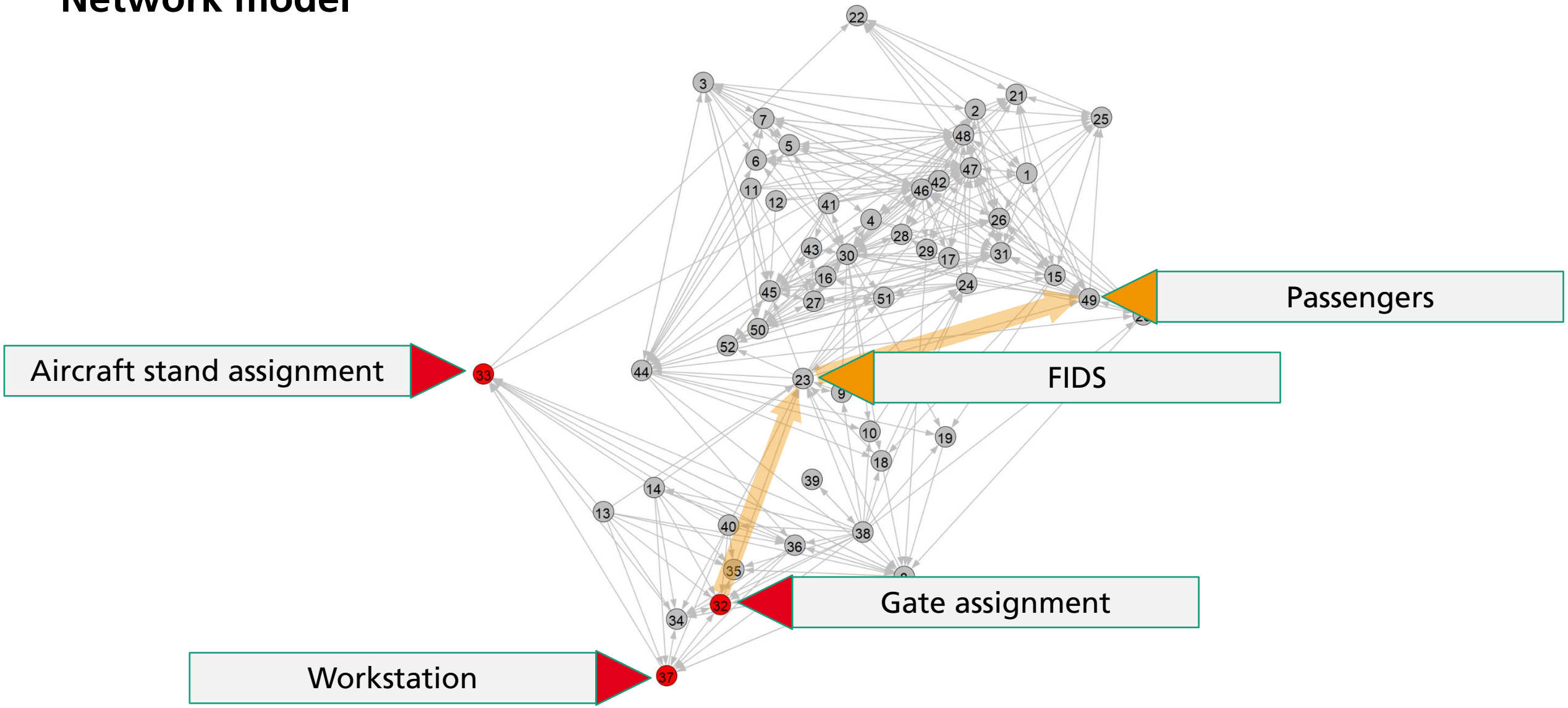
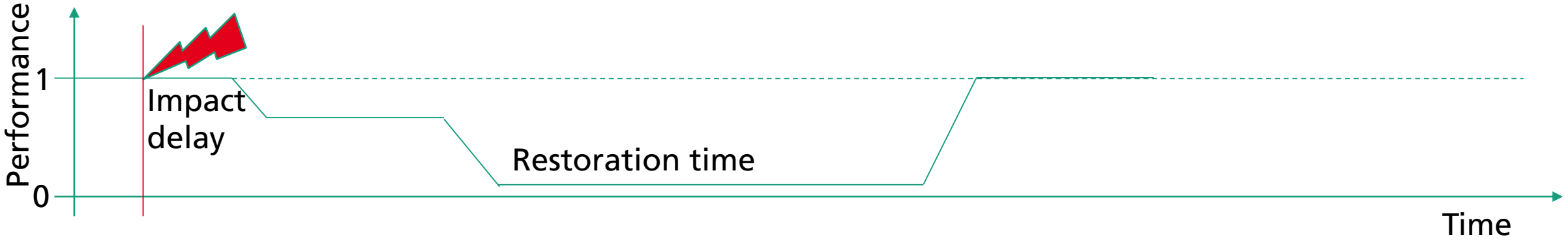
Network model

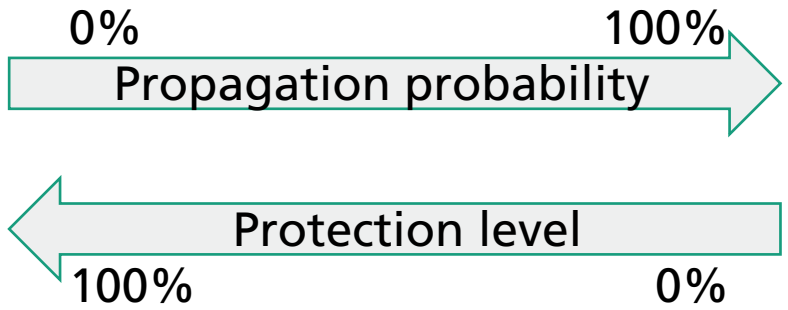
All nodes operational = 100% performance



Impact simulations

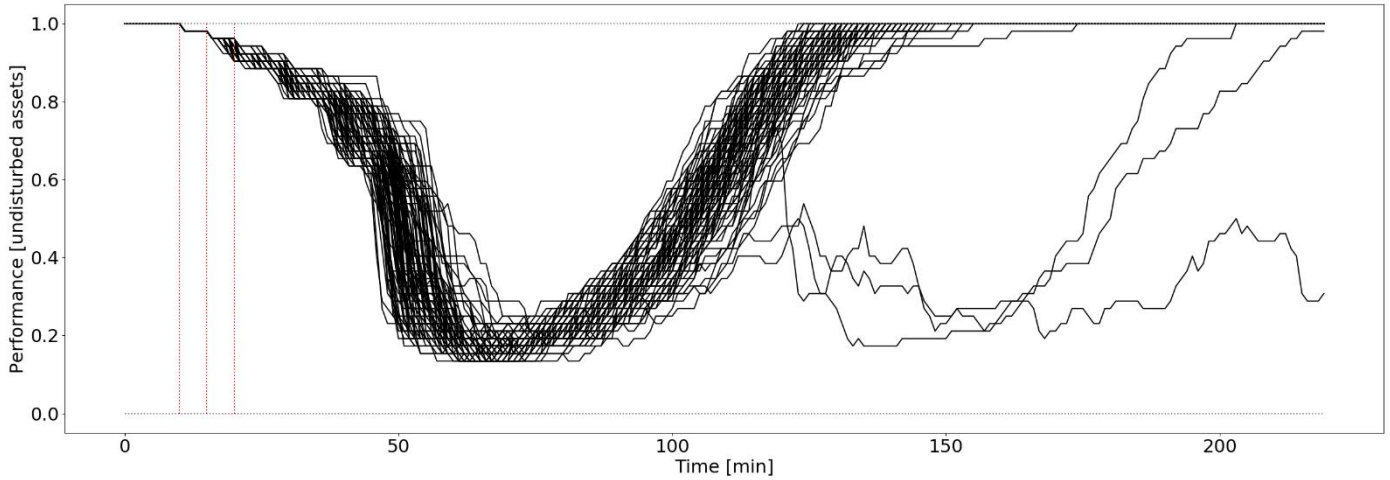


Grid node parameter	Value
Iterations	100
Time steps	300
Time steps length	1 min
Mean of impact delay time	10 min
Standard deviation of impact delay time	1 min
Mean of restoration time	60 min
Standard deviation of restoration time	10 min
Propagation probability	75%

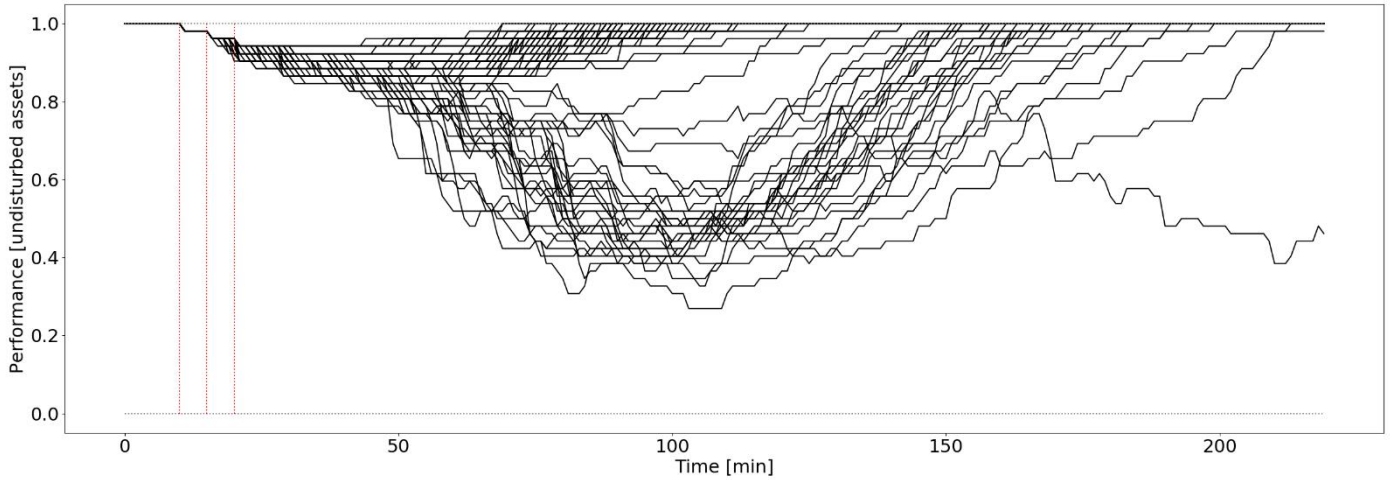


Simulation results

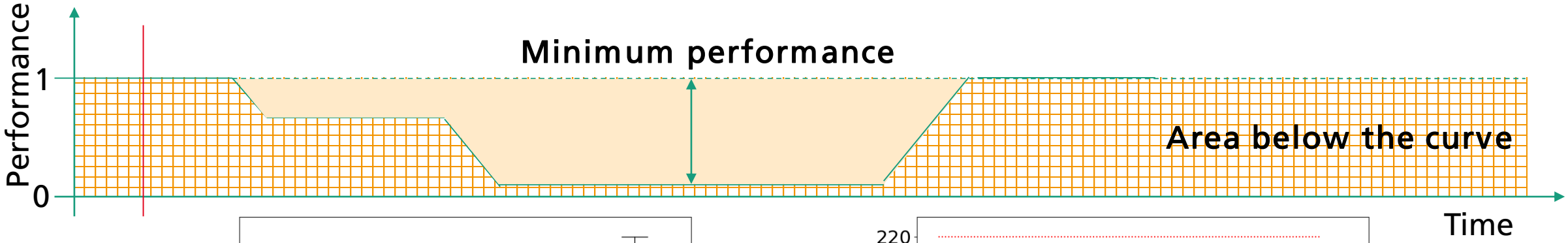
75% of propagation probability

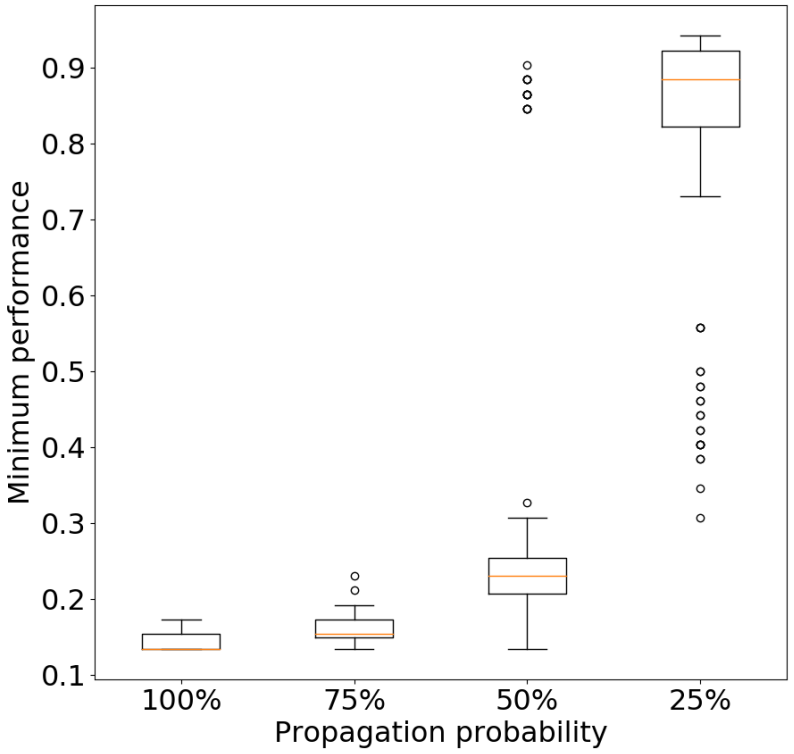


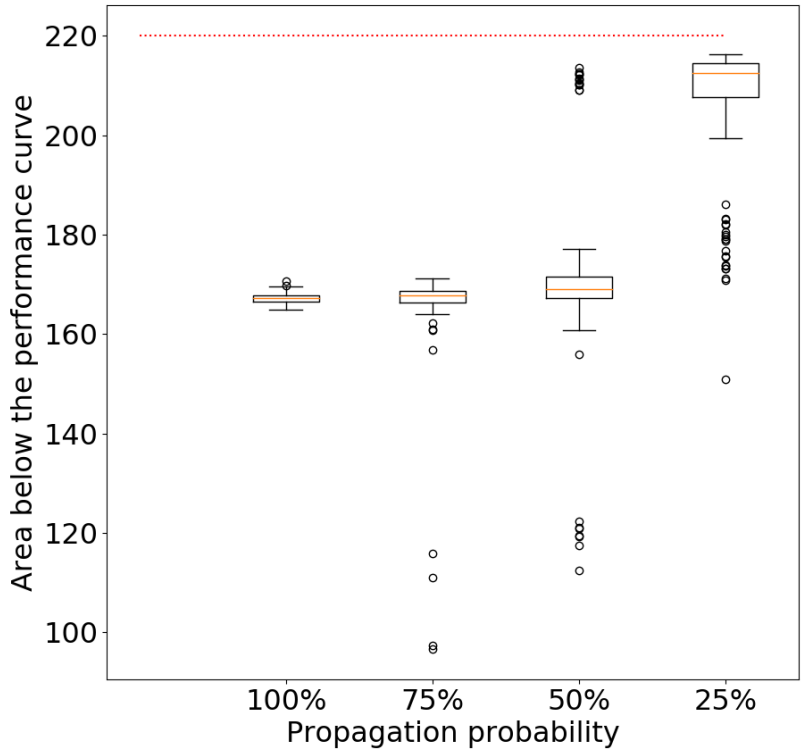
25% of propagation probability



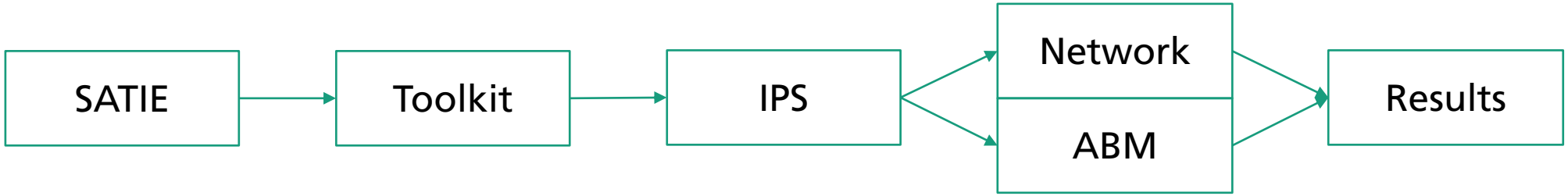
Resilience indicators







SUMMARY AND OUTLOOK



- Next steps:
  - Implement more realistic passenger behaviour.
- Future application:
  - Optimize evacuation scenarios and test mitigation strategies.
  - Use IPS in the design process of infrastructure.

THANK YOU VERY MUCH FOR THE ATTENTION

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