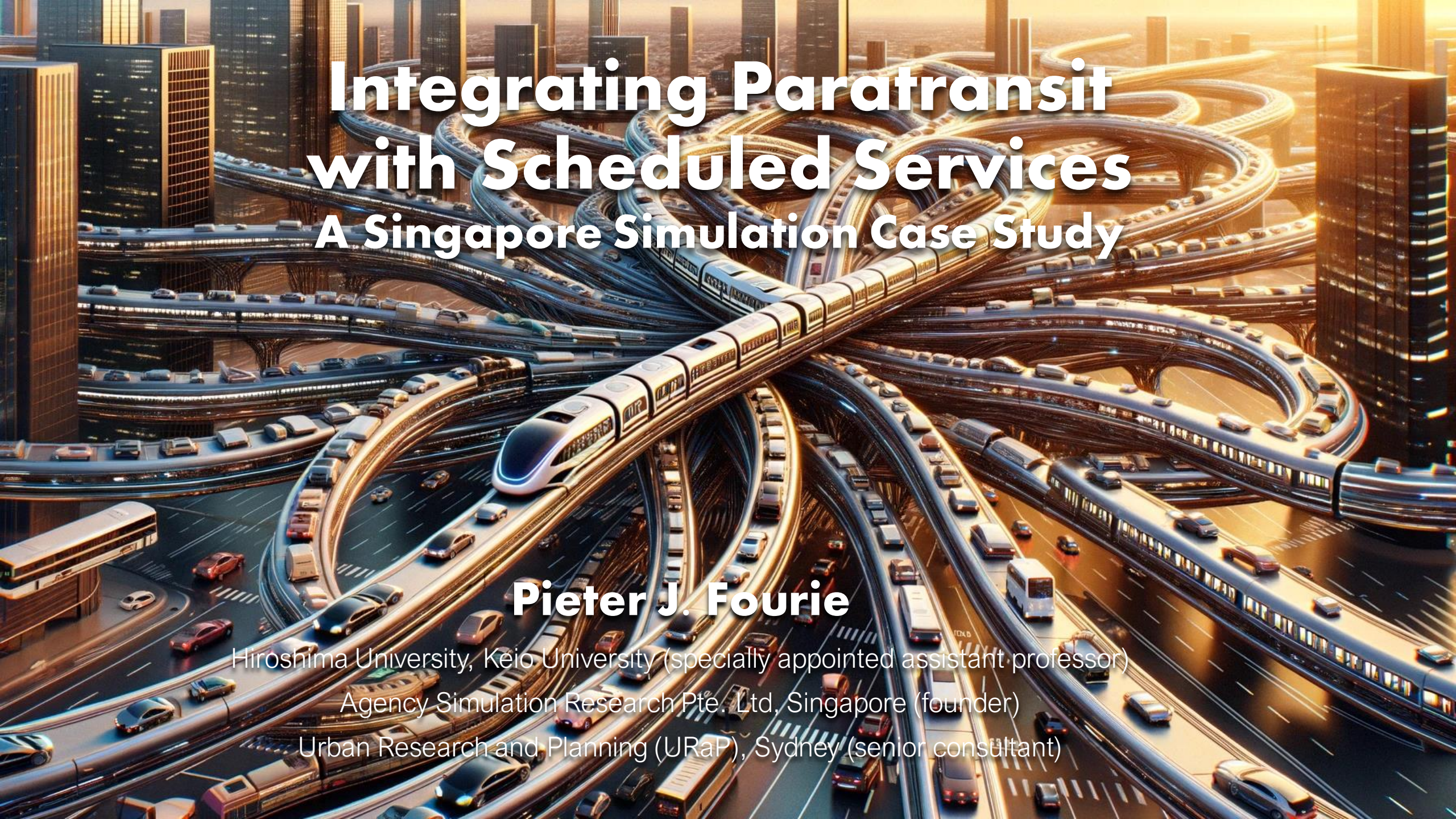

Integrating Paratransit with Scheduled Services

A Singapore Simulation Case Study

Pieter J. Fourie

Hiroshima University, Keio University (specially appointed assistant professor)

Agency Simulation Research Pte. Ltd, Singapore (founder)

Urban Research and Planning (URaP), Sydney (senior consultant)

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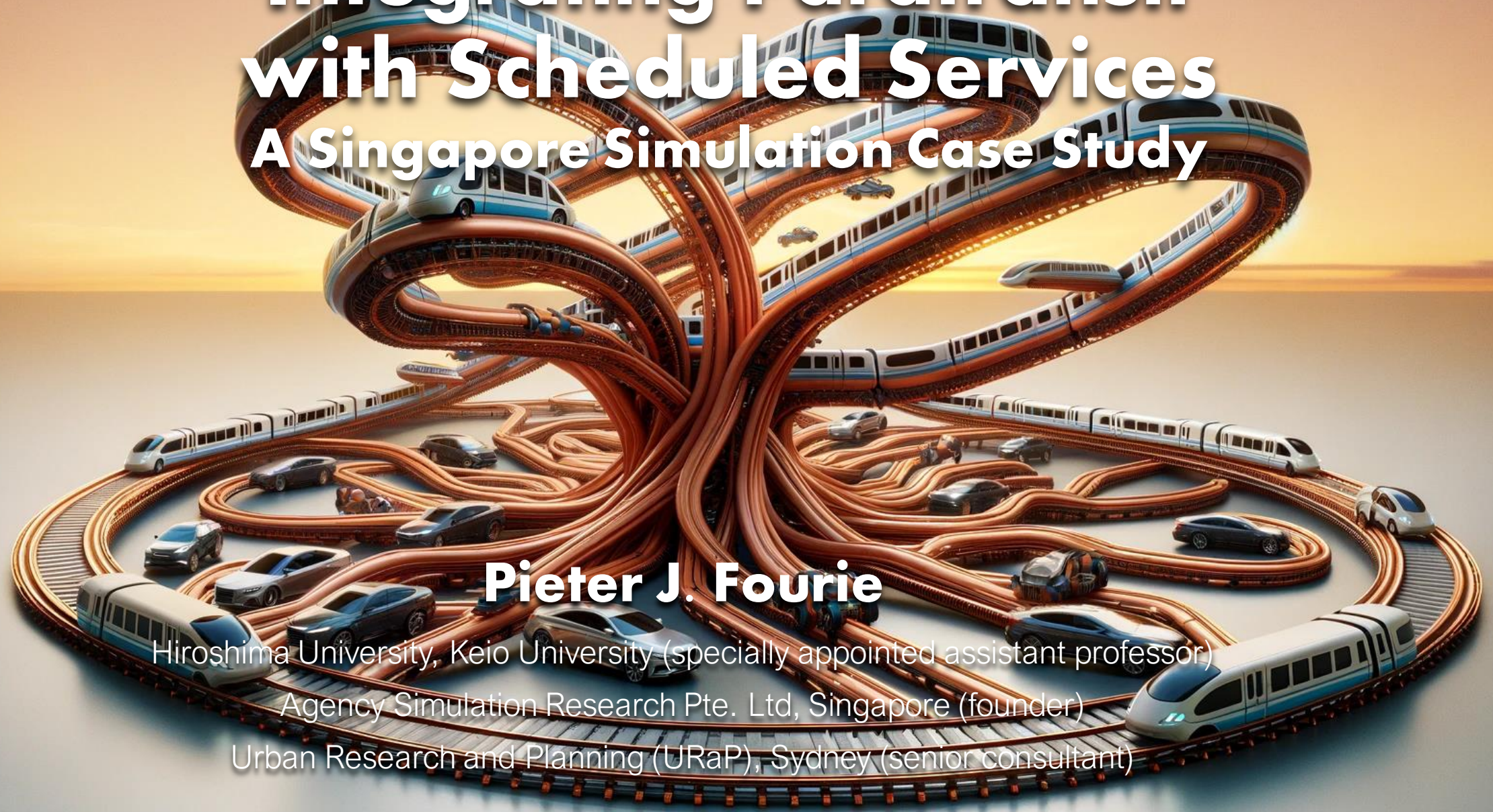

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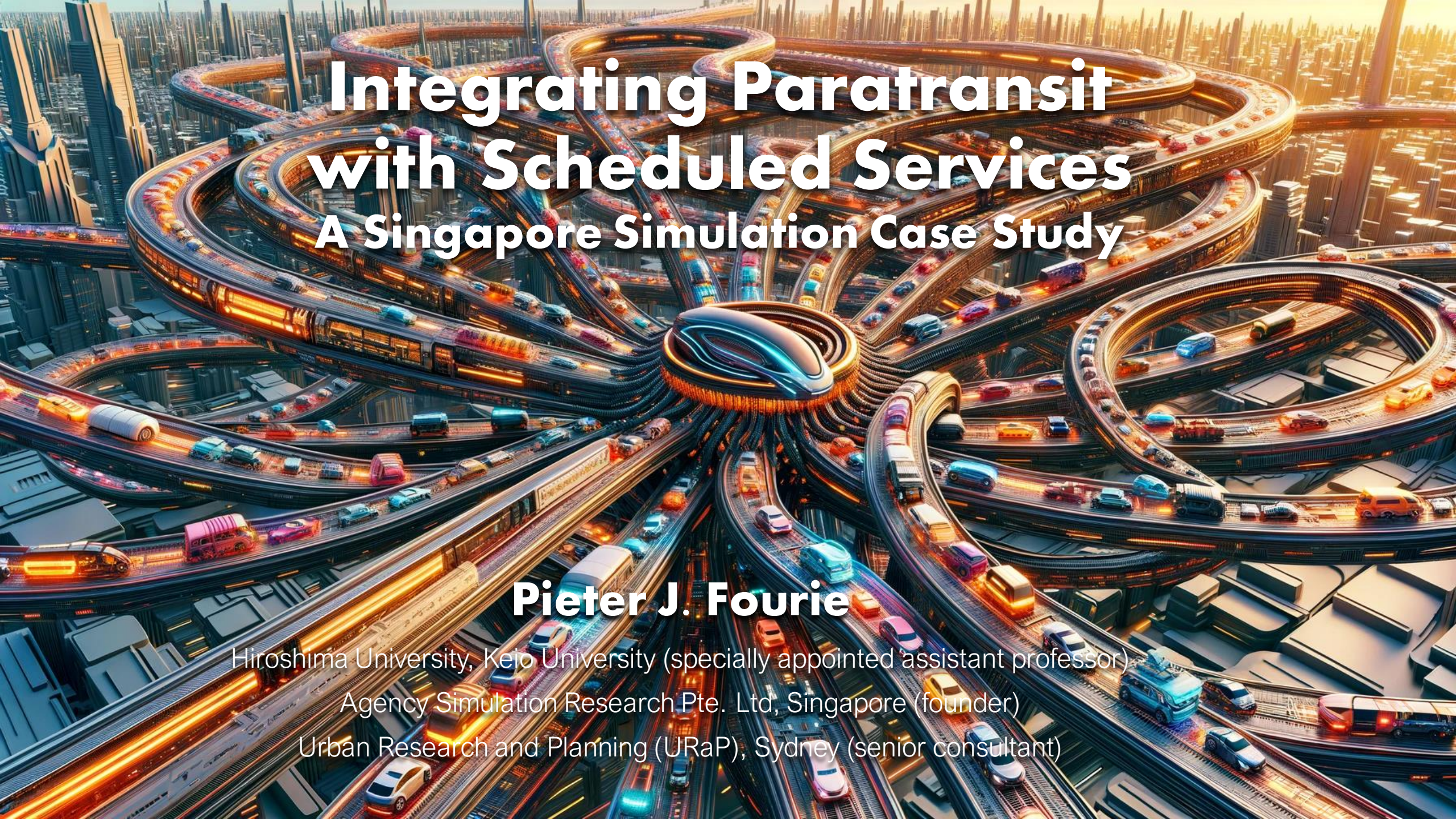

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The MATSim Singapore team (2011-2015)

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Project Leader

Prof. Dr. Kay Axhausen
Co-PI,
Project advisor

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Operations Research, transport and land-use modelling

Sergio Ordonez
PhD student
Computer Scientist

Dr. Basil Vitins
Transport modelling and simulation expert

Michael van Eggermond
Phd student
Modelling and data warehouse

Artem Chakirov
PhD student
Electric Engineer

Dr. Lijun Sun
Data scientist

The MATSim Singapore team (2016-2020)

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Co-PI

Dr. Michael v. Eggermond
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Senior Researcher

Dr. Sergio Ordonez
Senior Researcher
Computer Science

Tanvi Maheshwari
PhD Researcher
Urban Design

Biyu Wang
MATSim developer

Cuauhtémoc Anda
PhD Researcher
Data Scientist

MATSim Singapore

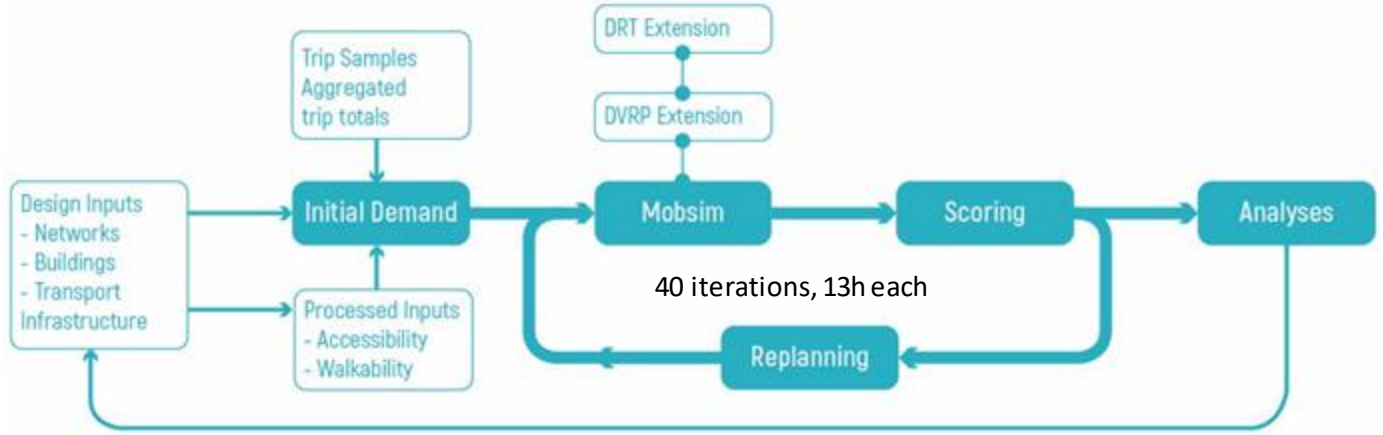
- 2011: Weighted sampling of 2008 Household Interview Travel Survey (HITS) travel/activity schedules, scraped GTFS for transit, Navteq navigation network
- 2012: Population synthesis, gravity-based work & school location assignment, activity schedule sampling, work start time + duration clustering, work location capacity inference from transit smart card data and HITS, road pricing
- 2013-2015: Data-driven transit simulation
- 2015-2016: Re-implementation with URA, LTA data – Bayesian network-based population synthesis, full choice modelling stack informed by micro- and macro-based accessibility, machine learning for activity chains
- 2017: Application for feasibility study of e-scooter deployment
- 2017-2020: Application for autonomous transit-on-demand deployment, integration with scheduled services in 2030

Design. Simulate. Repeat.

AN URBAN DESIGN RESPONSE TO THE TECHNOLOGICAL SHIFT IN TRANSPORTATION

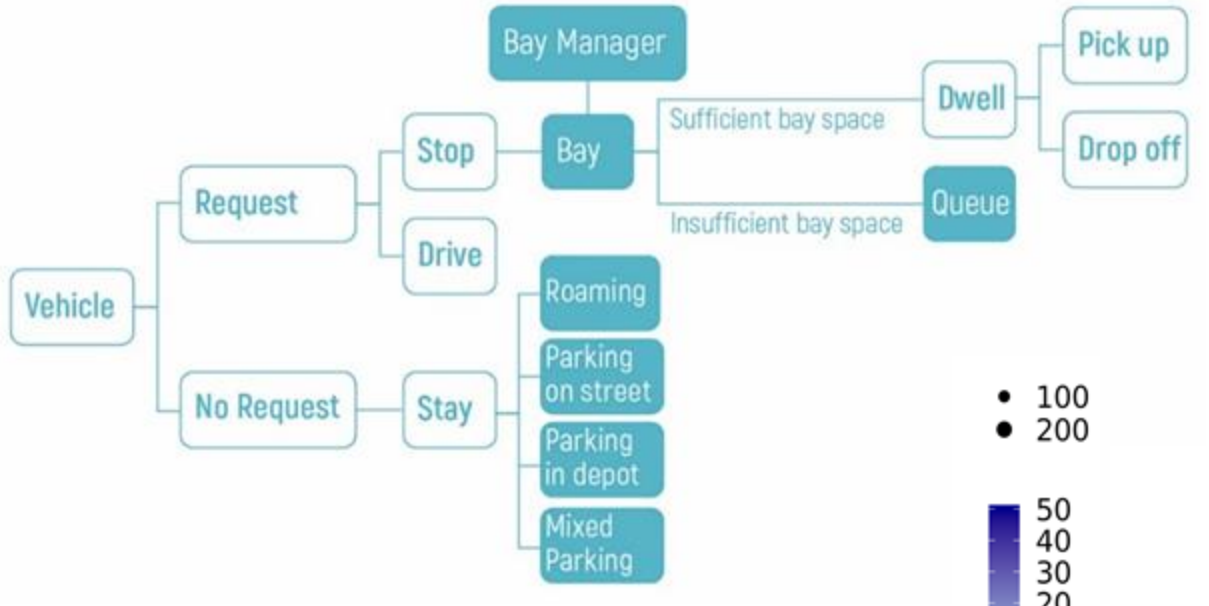
How to conduct urban design with vehicle automation, sharing and connectivity

Translating designs into agent-based traffic simulations allows a co-evolution of urban form and resulting flows.



Simulation extensions

Evaluation of spatial restrictions



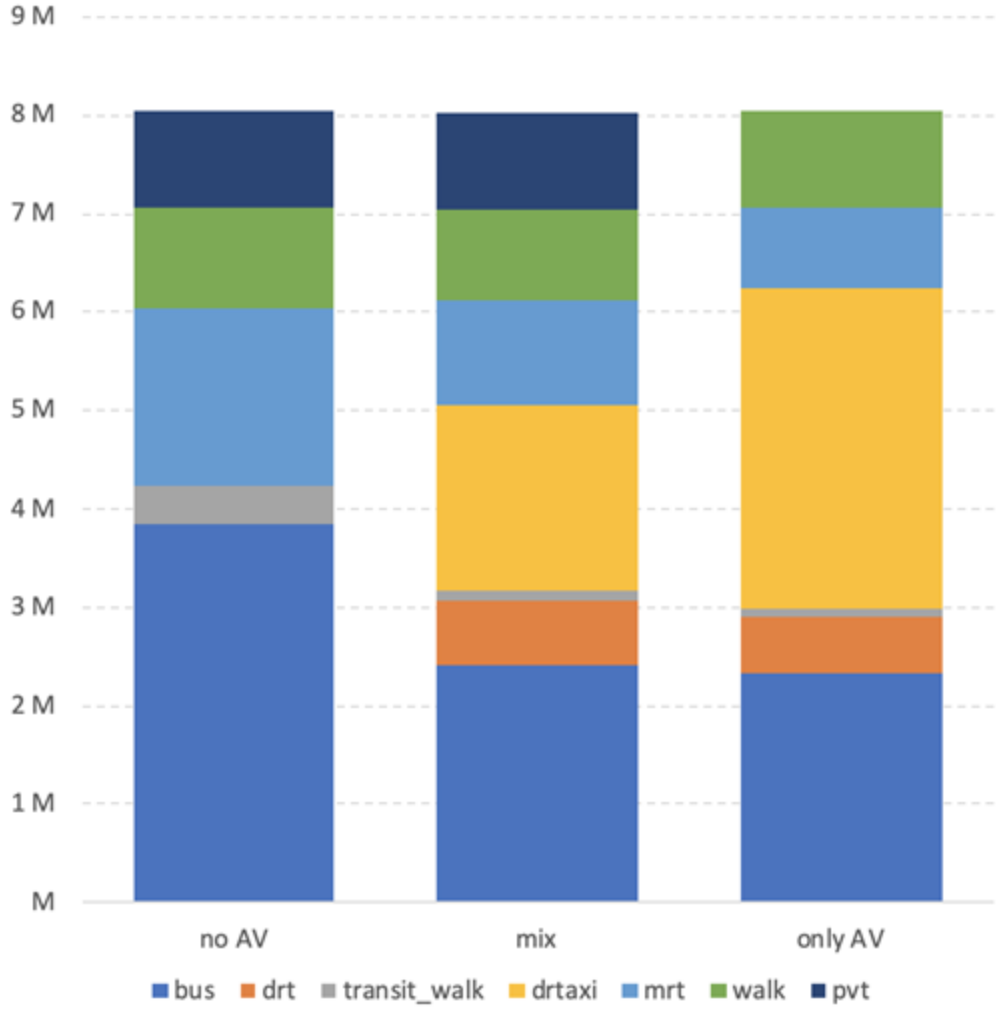
Don’t build more parking.

Avg:
HDB: 3.7
depot: 80.5
street: 2.5

We built several extensions to MATSim AMOD, including several parking strategies.

As the map shows, AVs can park in HDB lots (orange), dedicated depots (black) and on unused streets (purple).

Car users will switch to AV taxis, unless there are bus stops.



- The graph shows mode share by main mode of travel (mode longest distance traveled)

- transit_walks eliminated due to fewer transfers.

- drtaxi (door-to-door) replaces car, typically as there are no bus stops around for drt.

- drt is primarily a connecting mode (first/last mile)

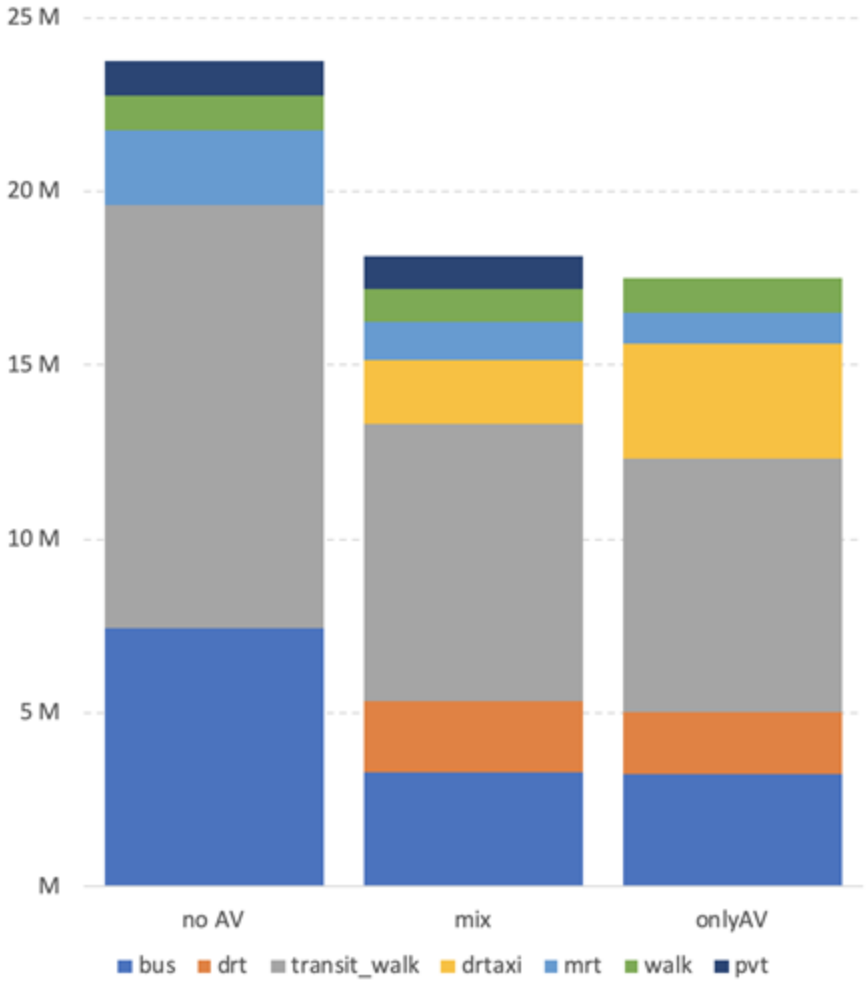
- Walkers tend to be short trips, where taking transit doesn't make sense.

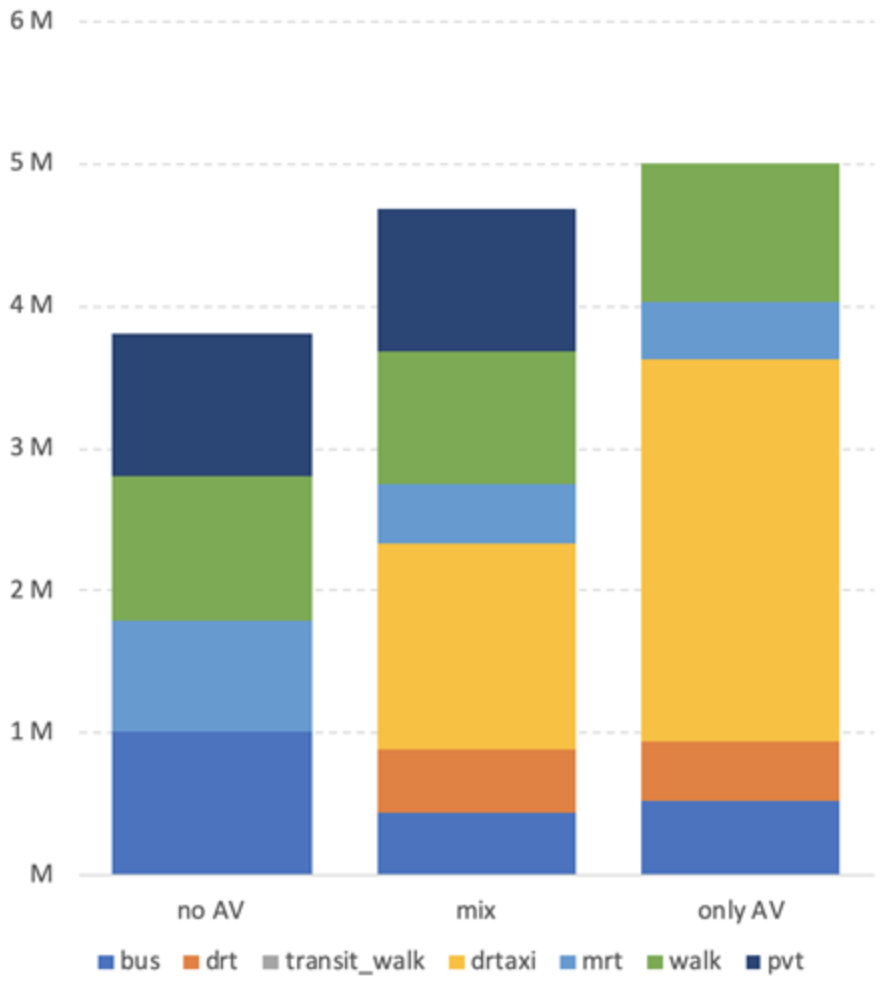
- Hundreds of thousands of bus trip stages are eliminated, especially where the user previously needed to switch buses in the no AV scenario.

- Direct trips for non-car owners increase by ~30% when AVs are introduced.

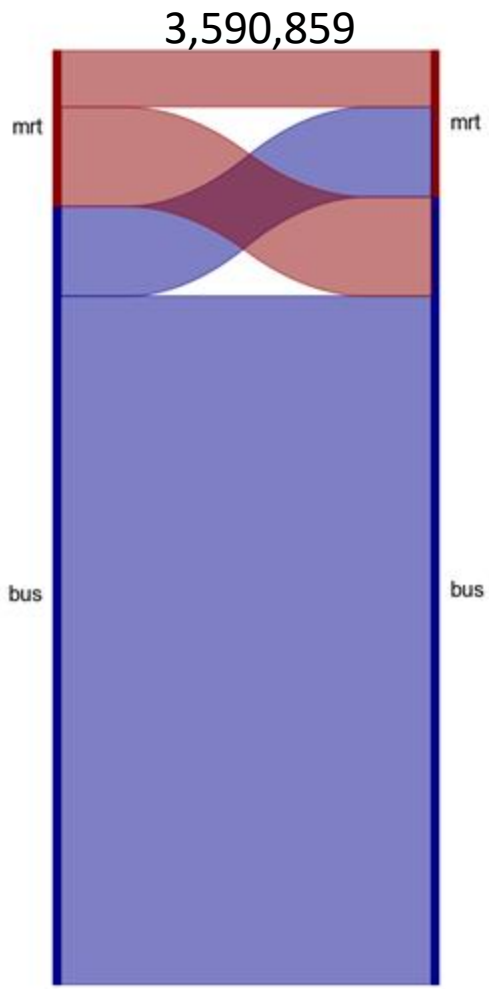
More direct trips, fewer transfers.

Fewer trip stages (left) and more direct trips (right) mean less PKT.





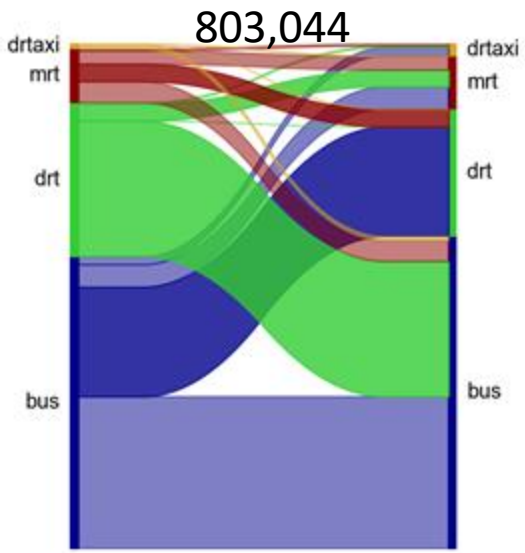
It's all about first mile/last mile.

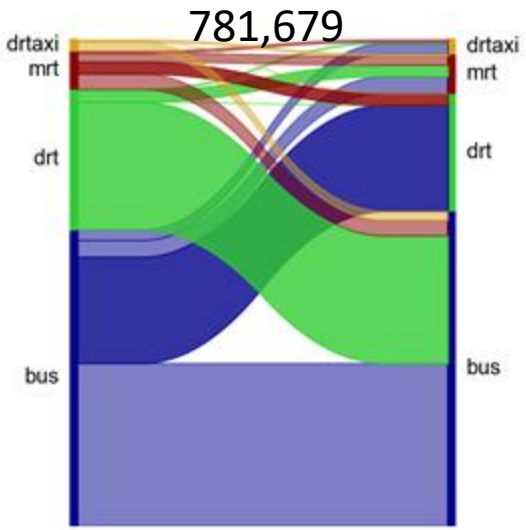


- The graph represents the transfer volumes between transit modes for the 3 scenarios. First mile last mile are highlighted.

- When AMOD is introduced the total number of transfers decreases dramatically due to drtaxi and because direct bus services become more reliable.

- Buses see elimination of denied transfers, bus bunching, bus-to-bus transfer boardings/alightings.





Router structure

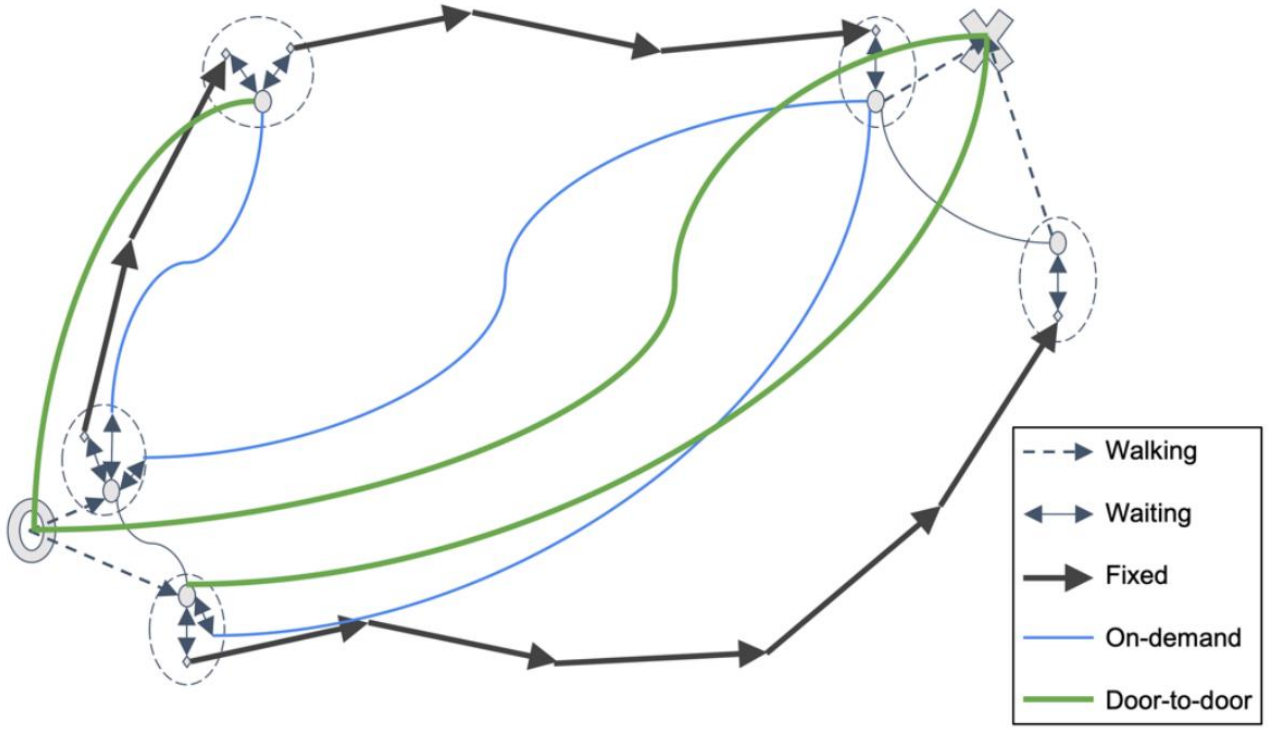
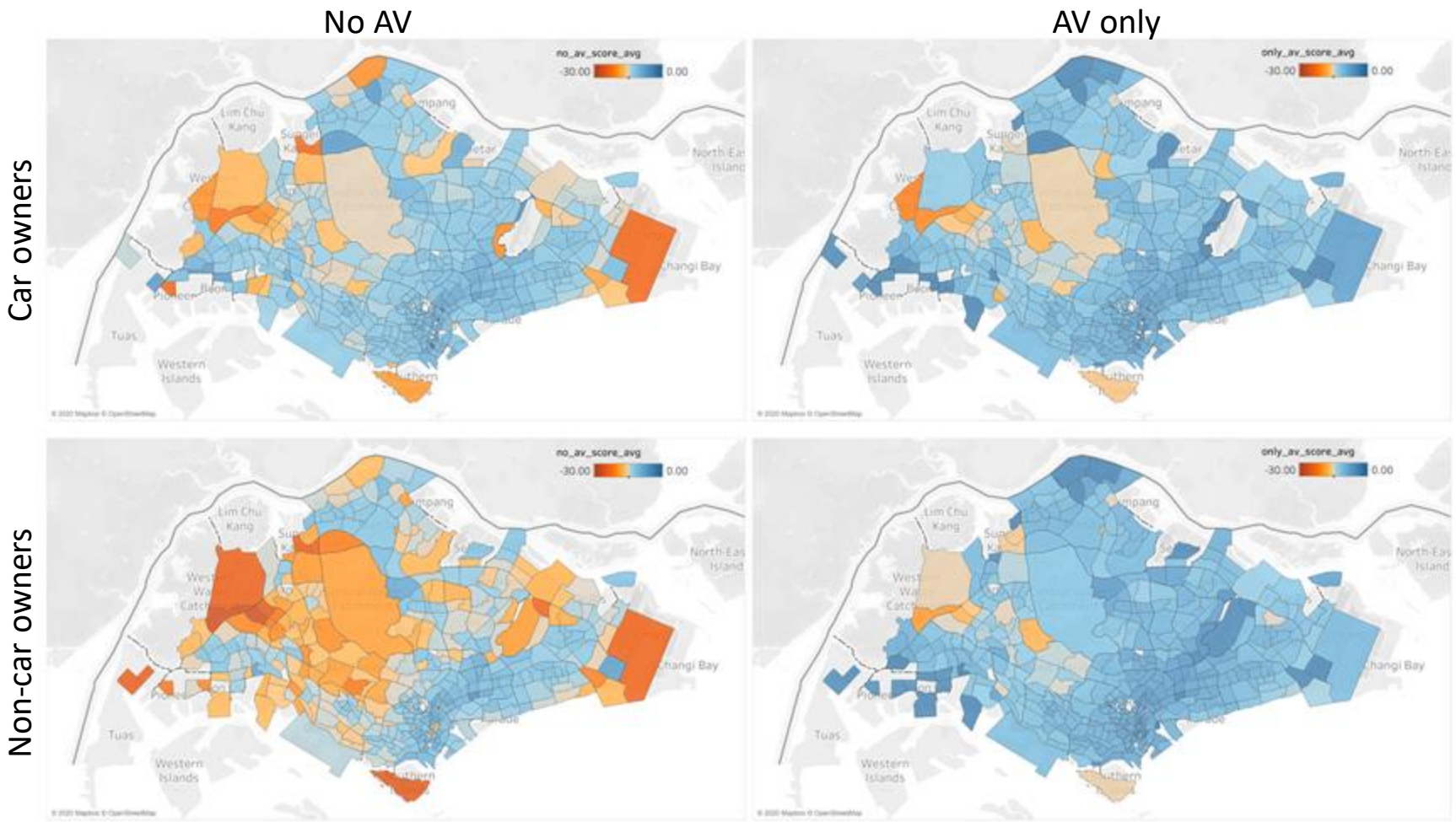


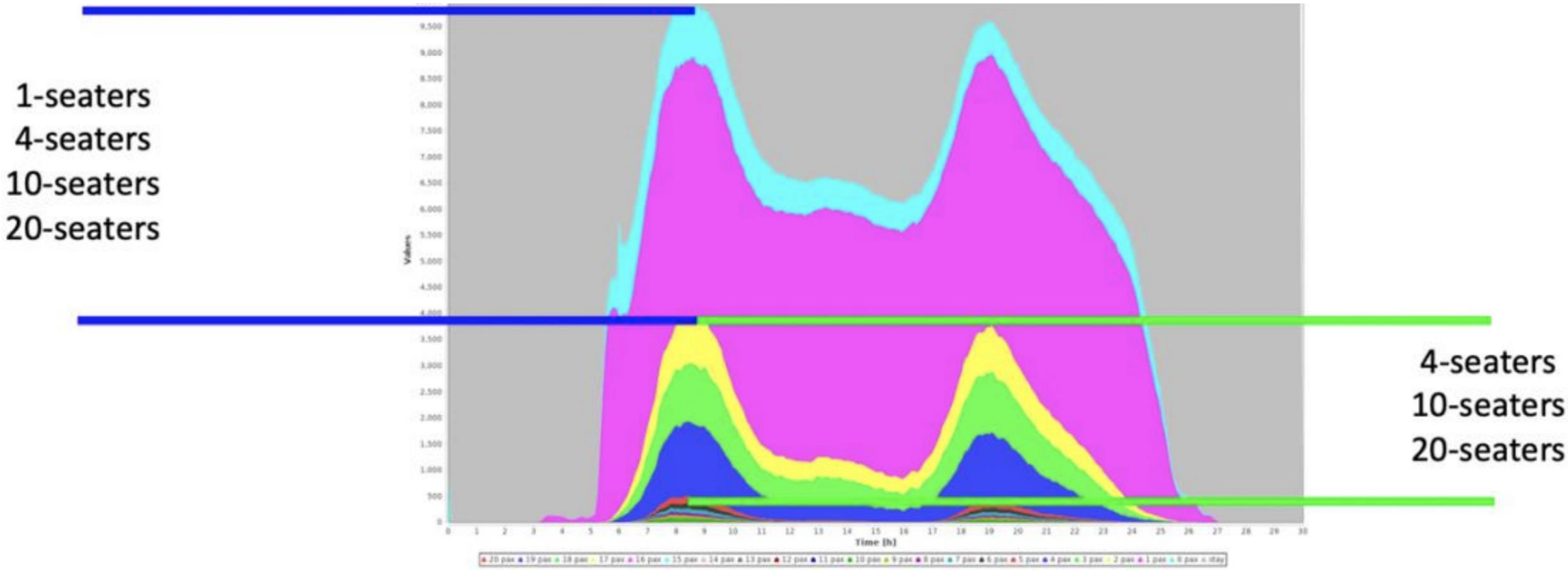
Figure 16 Router network structure for an origin and a destination

Integrated AMOD/transit = more equitable, reliable, accessible SG.



Blue is better. When cars are eliminated, agent full day scores improve. This means, overall, agents spend less time and money travelling, spend more time at activities, and are punctual - an agent's score is the sum of generalised costs of activity participation (positive), travel (negative) and arriving late (very negative). Less variation in colour means higher equitability - agents' plans are equally realisable without incurring penalties. When we plot the variation in score (annex), AV-only scenario also performs better, meaning overall system reliability is higher as agents' experience is more uniform.

Fleet size


1-seaters
4-seaters
10-seaters
20-seaters
4-seaters
10-seaters
20-seaters
Values
Time [h]